Genetic Toxicology Encyclopedia Article

Genetic Toxicology

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Genetic Toxicology

Genetic toxicology is the study of chemicals and other environmental agents to evaluate their potential to interact with or cause damage to genetic cellular processes. Two aspects of genetic damage that are frequently studied are the potential to induce **cancer** (carcinogenicity) and the ability to cause **gene** mutations (mutagenicity). Less commonly, studies are directed toward the potential to cause **chromosome** breaks (clastogenicity), to disrupt normal segregation of chromosome pairs or chromatids, to inhibit normal spindle formation, or benign attributes of genetic processes such as **sister chromatid exchange**, which correlate with genetic damage even though they themselves are not harmful to the **cell**.

The remarkable similarity of the cellular mechanisms used to replicate the **DNA** across a wide variety of organisms allows the use of animal, plant, and bacterial cells in genetic toxicology studies which are primarily designed to screen for agents which might cause genetic damage in humans.

Short-term tests are simple and inexpensive laboratory tests, which are designed to detect some single aspect of genetic alteration or damage. These include assays such as the Ames test, which employs bacterial cells to screen for gene mutations, the micronucleus test that evaluates chromosomal loss in mammalian cells, and the unscheduled **DNA synthesis** test, which detects increased levels of **DNA repair**. While many of these tests utilize animal or bacterial cells for study, there are a variety of human toxicology tests that use human cell cultures. Such testing is called *in vitro* testing. There are dozens of different short term tests which each look at slightly different biological endpoints to determine the genotoxic potential of different agents. Short term tests allow for rapid screening of large numbers of chemicals or other agents with relatively low cost.

Chronic testing in intact animals, usually mice or rats, allows for a thorough study of gentoxicity across the lifespan of the organism. The endpoint in these studies is usually cancer. While these long term studies are far more expensive, they take all of the biological complexity into account and reflect more fully the overall impact of each agent being tested.