# Undergraduate Diversity Program Objectives

### Content Objectives

1. Increase awareness of toxicology as a scientific discipline and as a choice for a research career through which an individual can make important contributions to society and the environment.
2. Encourage students to seek graduate training in the biomedical sciences.
3. Improve knowledge of basic principles and concepts of toxicology, including:
   a. The dose determines the poison (risk/benefits of chemicals) and other science concepts.
   b. Toxicology research is important for protecting and improving the health of humans, animals, and their environment.

## Brief Outline of Key Toxicology Concepts

### Toxicology as a Science and as a Career

**1. Toxicology** is the science that studies the harmful effects of overexposure to drugs, environmental contaminants, and naturally occurring substances found in food, water, air, and soil.

- Main **objectives are to establish safe doses and determine mechanisms of biologic action of chemical substances**.
- **A career in toxicology** involves evaluating the harmful effects and mechanisms of action of chemicals in people, other animals, and all other living things in the environment.
- This work may be carried out in **government, private industry and consulting firms, or universities and other research settings**.
- Toxicologists routinely **use many sophisticated tools** to determine how chemicals are harmful. Some state-of-the-art methods used include computer simulations, computer chips, molecular biology, cultured cells, and genetically engineered laboratory animals.

**2. *Some* basic toxicology concepts and principles:**

- **"The dose makes the poison" is the first principle of toxicology. Highly toxic chemicals can be life saving when given in appropriate doses.** On the other hand, **an apparently nontoxic chemical can actually be toxic at high doses.** In other words, it is possible to be exposed to "too much of a good thing"!
- **"Exposure" and "dose" are different concepts.** Many biological and physical/chemical factors determine how much of chemical in one's environment (i.e., exposure) reaches sensitive vital internal organs in an active form that causes harm (i.e., dose to target organ). Thus, the amount of a chemical that is "out there" in one's environment is not as important a determinant of toxicity as the actual internal dose.
- **Biological differences** between species and individuals (e.g., age, gender, metabolic status, diet, and genetic differences) play important roles in determining toxicity. The **physical state** of a chemical (liquid, solid, gas) at the time of exposure determines toxic effects.
- **Route of exposure matters.** A chemical that is toxic when taken by one route of exposure (e.g., inhalation, dermal absorption, or ingestion) may not be toxic by another route.
- **Source is not a reliable predictor of toxicity.** Overexposure to **any** chemical, whether synthetic or natural—even water or oxygen—may be too much of a good thing!

- **The work of toxicologists improves the health and prosperity of society and our environment.** For example, toxicology studies are required to identify levels of chemicals in the environment that will not cause harm to people or animals, and levels of valuable medicines, household and gardening chemicals, and industrial and natural compounds that people can use without unnecessary risks.
- Some toxicology research also determines how chemicals cause injury (i.e., mechanism studies). These studies **provide information that can be used in the treatment of poisonings, to develop new uses for existing chemicals, and to contribute to a better understanding of fundamental biologic processes** in humans, other animals, and plants.
- The use of *in vivo* (animal) models enhances our ability to assess human risk of adverse effects to toxicant exposure and safety of new pharmaceuticals. The use of **laboratory animal models** is regulated by internationally accepted guidelines.
- **Exaggerated estimates of risk can also be "toxic"**—that is, prevent life-saving medicines and other useful chemicals from being developed and hinder economic progress. Toxicology allows us to examine and weigh the risks versus benefits of chemicals and optimize our lifestyles.
- Basing health risk assessments on objective toxicology and other sound scientific data **prevents improper regulation and ensures appropriate expenditures of public and private funds.**