

2.2: The Dose Response Relationship

The Dose-Response Relationship

The dose-response relationship is an essential concept in toxicology. It correlates exposures with changes in body functions or health.

In general, the higher the dose, the more severe the response. The dose-response relationship is based on observed data from experimental animal, human clinical, or cell studies.

Knowledge of the dose-response relationship establishes:

- **Causality** — that the chemical has induced the observed effects.
- The **threshold effect** — the lowest dose where an induced effect occurs.
- The **slope** for the dose response — the *rate* at which injury builds up.

Within a population, the majority of responses to a toxicant are similar; however, there are differences in how responses may be encountered – some individuals are susceptible and others resistant. As demonstrated in Animation 1, a graph of the individual responses can be depicted as a bell-shaped standard distribution curve. There is a wide variance in responses as demonstrated by the mild reaction in resistant individuals, the typical response in the majority of individuals, and the severe reaction in sensitive individuals.

Animation 1: A graph of individual responses to a substance, which generally take the form of a bell-shaped curve ([view full-text, PDF version](#))

The **dose-response curve** is a visual representation of the response rates of a population to a range of doses of a substance, as demonstrated in Animation 2 (available at [ToxTutor](#)). *The graph of a dose-response relationship typically has an "s" shape. ([view full-text, PDF version](#))*

Knowledge Check

1. The quantity of a substance administered to an individual over a period of time or in several individual doses is known as the:

- administered dose
- absorbed dose
- total dose

Answer

total dose

It is the quantity of a substance administered to an individual over a period of time or in several individual doses. It is particularly important when evaluating cumulative poisons.

2. Fractionation of a total dose so that the total amount administered is given over a period of time usually results in:

- decreased toxicity
- increased toxicity

Answer

decreased

toxicity

Fractionation of a total dose so that the total amount administered is given over a period of time usually results in **decreased toxicity**. This applies to most forms of toxicity but not necessarily to carcinogenicity or mutagenicity.

3. The usual dosage unit that incorporates the amount of material administered or absorbed in accordance with the size of the individual over a period of time is:

- PPM/hour
- mg/kg/day
- kg/100 lb/week

Answer

mg/kg/day

The usual dosage unit that incorporates the amount of material administered or absorbed in accordance with the size of the individual over a period of time is **mg/kg/day**. In some cases, much smaller dosage units, such as $\mu\text{g}/\text{kg}/\text{day}$, are used.

4. The dose at which a toxic effect is first encountered is called the:

- median toxic dose
- absorbed dose
- threshold dose

Answer

threshold dose

5. The dose-response relationship helps a toxicologist determine:

- whether exposure has caused an effect
- the threshold dose
- the rate of increasing effect with increasing dose levels
- all of the above

Answer

all of the above

The dose-response relationship demonstrates whether any effect has occurred, the threshold dose, and the rate at which the effect increases with increasing dose levels.

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