

Study Guide — BI Problem 4: Environmental Health (Mid-Unit Test)

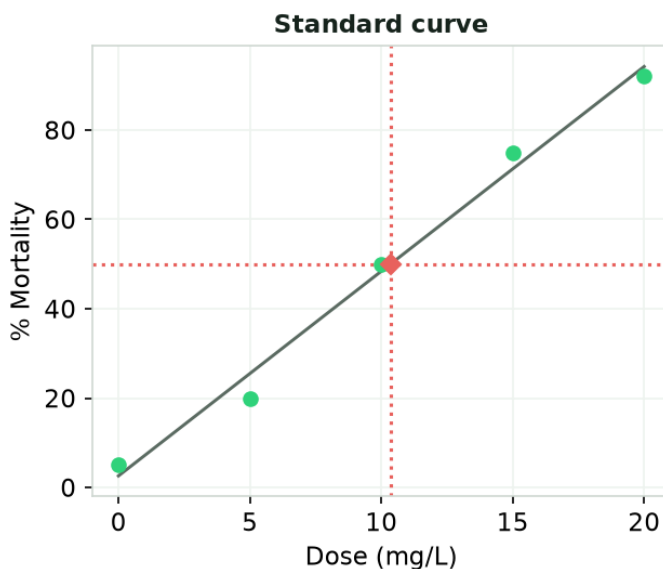
Biomedical Innovations · Problem 4 — Environmental Health · Modeled on the PLTW Guided Review format

Vocabulary to know cold

Term	Definition
Independent variable	The factor the experimenter deliberately changes (e.g., toxin dose).
Dependent variable	The measured response that may change because of the independent variable.
Controlled variable	A factor kept constant so it does not distort the comparison.
Negative control	A group with no treatment, showing the baseline response.
Positive control	A sample with a known amount of analyte that should test positive, confirming the assay works.
Dose-response curve	A graph of biological effect vs. dose, used to read values like LD50.
LD50	Dose lethal to 50% of the test population; lower LD50 = more toxic.
Correlation	A statistical association between two variables; does not by itself prove causation.
Confounding variable	An uncontrolled factor that can affect both variables and create a misleading association.
Replication	Using multiple samples per condition to estimate variability and improve reliability.
Error bar	A graphic showing the variability or uncertainty of a measurement.
Informed consent	Voluntary, informed agreement required before involving human subjects in a study.

Worked examples (follow the reasoning)

Example 1. A dose-response study of an algaecide on pond algae gives % survival of 95, 80, 50, 25, 8 at doses 0, 5, 10, 15, 20 mg/L. Estimate the LD50 (dose for 50% mortality).



- Convert survival to mortality: $100 - \text{survival} \rightarrow 5, 20, 50, 75, 92\%$.
- Find where mortality = 50%.
- Mortality equals 50% exactly at the 10 mg/L dose.
- Therefore the LD50 is read directly from the curve.

Answer: LD50 $\approx$ 10 mg/L.

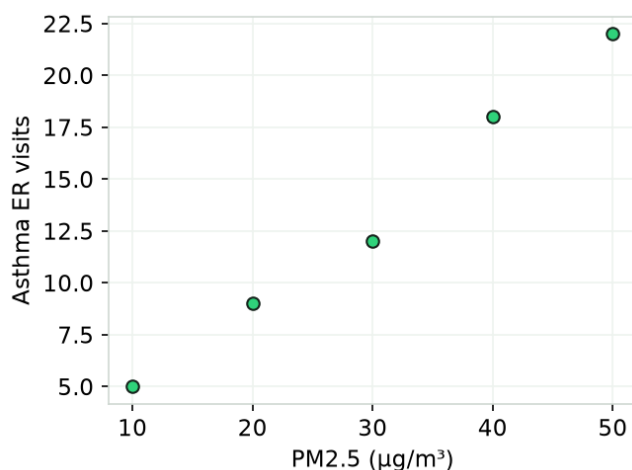
Example 2. Design a fair test of whether road-salt runoff reduces seed germination. List IV, DV, control, one controlled variable, and how you would add replication.

- IV = salt concentration in the water given to seeds.
- DV = percent of seeds that germinate.
- Negative control = seeds watered with salt-free water.
- Controlled variables = same seed type, light, temperature, soil, and water volume.
- Replication = many seeds (e.g., 25) per salt concentration, repeated in 3 trays.

Answer: IV salt conc.; DV % germination; control = 0 salt; keep seed/light/temp/volume constant; 25 seeds × 3 trays per dose.

Practice questions (with reasoning)

1. A scatter plot shows asthma ER visits rising with daily air-particulate levels. The correct interpretation is:



- A. Particulates definitely cause asthma
- B. A positive correlation exists; causation needs more study
- C. No relationship
- D. Negative correlation

Answer: B. Points rise together (positive correlation), but correlation alone does not establish causation.

2. Which addition would MOST improve the reliability of a one-beaker toxicity test?

- A. Using a prettier graph
- B. Running several replicate beakers per dose
- C. Removing the control
- D. Testing only one dose

Answer: B. Replicates per dose let you estimate variability and increase reliability.

3. An assay run with no positive control gives all-negative results. The problem is you cannot tell whether:

- A. The samples are truly clean or the assay simply failed
- B. The graph is colorful
- C. The LD50 is high
- D. The room is warm

Answer: A. Without a positive control you cannot distinguish a true negative from a failed assay.