

INKBIOLOGY FLASHCARDS

Scientific method and quantitative biology

Unit B00 · 26 cards · fronts and backs

Print double-sided, flipping on the long edge, and each answer lands behind its question. Cut along the card borders.

Definitions in mark-scheme wording, and the misconceptions that lose marks. These cards and each lesson's whole-lesson check run on the website with spaced-repetition scheduling, at inkphysics.co.uk/biology/flashcards.

DEFINITION

Define: Independent variable.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Dependent variable.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Control variable.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Control experiment.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Confounding variable.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Randomisation.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Correlation.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Causation.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

The quantity you measure, whose value depends on the independent variable. It goes on the vertical axis.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

The quantity you change on purpose, and the only one that should differ between your treatments. It goes on the horizontal axis.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

An extra run of the method, differing in one deliberate way, done to rule out an explanation the main runs cannot rule out on their own.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

A quantity held the same across every treatment, so that it cannot be the reason the dependent variable changed.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Assigning subjects or sample positions by chance rather than by choice, so that variables nobody thought of tend to balance out between the groups on average.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

A variable that changes with the independent variable and could itself explain the change in the dependent variable, so the two effects cannot be separated by the data collected.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

A relationship in which changing one variable changes the other. It cannot be read off a scatter graph.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

A relationship in which two variables tend to change together. It may be positive, negative or absent, and it makes no claim about which variable moved first.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Valid.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Accurate.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Precise.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Repeatable.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Reproducible.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Resolution.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

SPOT THE ERROR

Say what is wrong with this claim:

A control is the tube you leave the interesting thing out of, and every experiment has one.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Significant figures.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

DEFINITION

Close to the true value.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

A measurement is valid if it measures what it claims to measure; an investigation is valid if its design allows its conclusion to follow. A confounding variable destroys validity however careful the measuring was.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

The same person, using the same method and the same apparatus, gets the same results again.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Repeat readings close to one another. Precision says nothing at all about being right.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

The smallest change an instrument can register: 0.01 g on a three-decimal-place balance, 1 mm on a metre rule.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Somebody else, or the same person using different apparatus or a different method, gets the same results.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

The digits in a measurement that carry information about its size, counted from the first non-zero digit.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

SPOT THE ERROR

Two different things share the word. A control variable is a quantity held still; a control experiment is a whole extra run of the method. Plenty of sound investigations need no control tube at all: a potometer measuring uptake at five wind speeds has controlled variables everywhere and none.

VARIABLES AND CONTROLS: WHAT AN EXPERIMENT CAN SHOW

DEFINITION

Define: Leading zeros.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

DEFINITION

Define: Trailing zeros after a decimal point.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

SPOT THE ERROR

Say what is wrong with this claim:

You give your answer to the same number of decimal places as the numbers in the question.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

DEFINITION

Define: Mean.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE

DEFINITION

Define: Median.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE

DEFINITION

Define: Mode.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE

DEFINITION

Define: Null hypothesis.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE

DEFINITION

Define: Significance level.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE

DEFINITION

Always significant. 4.20 has three, and says the hundredths digit was measured.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

DEFINITION

Never significant. 0.0043 has two significant figures, because the zeros only locate the decimal point.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

DEFINITION

The total divided by the number of readings. Uses every value, and is what almost every biological calculation wants.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE TYPES OF MEAN

SPOT THE ERROR

Significant figures, not decimal places. A leaf measured at 43 mm has two significant figures; written as 0.043 m it has three decimal places and still two significant figures, because changing the unit cannot improve the ruler.

HANDLING DATA: UNITS, SCALES, RATES AND UNCERTAINTY

DEFINITION

The most common value. The only one of the three that works for categories such as blood group or flower colour.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE TYPES OF MEAN

DEFINITION

The middle value when the readings are put in order. Unmoved by a single extreme value, which is why it is used for skewed data such as incomes, reaction times or the number of parasites per host.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE TYPES OF MEAN

DEFINITION

The probability threshold, conventionally 0.05, below which the null hypothesis is rejected.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE TYPES OF MEAN

DEFINITION

A statement that there is no significant difference, no significant association or no significant correlation between the variables, and that any difference observed is due to chance.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE TYPES OF MEAN

DEFINITION

Define: Degrees of freedom.

SPOT THE ERROR

Say what is wrong with this claim:

If the error bars on two means do not overlap, the difference between them is significant.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THREE TESTS

SPOT THE ERROR

Non-overlapping bars are a hint, not a verdict, and what they support depends on what they show: one standard deviation, one standard error and a 95% confidence interval have different lengths on the same data. Only the test decides.

DEFINITION

A number derived from the size of the data set that decides which critical value you read from the table.

STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THRESHOLD STATISTICS FOR BIOLOGISTS: SPREAD, ERROR BARS AND THE THRESHOLD