Name: _____ **Date:** _____

Answer Key: When Paradigms Shift: A College Guide to Scientific Inquiry

Can we ever truly prove a theory? Analyze the epistemological boundaries of falsification, Bayesian inference, and the replication crisis in modern research.

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1. In the context of Karl Popper's philosophy of science, which criterion distinguishes a scientific theory from a pseudoscientific one?

Answer: B) The inherent risk that the theory can be falsified by empirical observation

Popper argued that for a theory to be scientific, it must be 'falsifiable'—meaning there must be a logically possible observation that could prove it wrong.

2. In a robust experimental design, researchers must account for _____ variables, which are extraneous factors that correlate with both the dependent and independent variables, potentially leading to a type I error.

Answer: B) Confounding

Confounding variables can suggest a causal relationship where none exists or mask a true relationship by distorting the effect of the independent variable on the dependent variable.

3. The Bayesian approach to the scientific method emphasizes the updating of prior probability distributions with new evidence to reach a posterior probability, rather than relying solely on p-values.

Answer: A) True

Bayesian inference incorporates prior knowledge or beliefs (priors) and updates them as data is collected, offering an alternative to frequentist null-hypothesis significance testing.

4. Thomas Kuhn's 'The Structure of Scientific Revolutions' suggests that 'normal science' operates within a framework that remains unchallenged until what occurs?

Answer: C) Anomalies accumulate that the existing paradigm cannot explain

Kuhn argued that a 'paradigm shift' occurs when enough anomalies (results that contradict the current framework) build up to trigger a crisis, leading to a new scientific worldview.

5. When a researcher selectively reports only the data that supports their hypothesis while ignoring non-significant results, they are engaging in a practice known as _____.

Name: _____ **Date:** _____

Answer: C) P-hacking

P-hacking (or data dredging) involves manipulating data analysis until non-significant results become significant, which contributes heavily to the replication crisis.

6. In a double-blind randomized controlled trial, the participant is aware of the treatment group assignment, but the researcher administering the treatment is not.

Answer: B) False

In a double-blind study, neither the participants nor the researchers/investigators know who is receiving the active treatment or the placebo to eliminate bias.

7. Which of the following best describes the 'Replication Crisis' currently affecting social and biomedical sciences?

Answer: B) The inability of independent researchers to reproduce the results of published studies

The replication crisis refers to the alarming finding that many significant scientific studies are difficult or impossible to replicate, calling the reliability of those findings into question.

8. The principle of _____, often referred to as Occam's Razor, suggests that when presented with competing hypotheses that make the same predictions, the one with the fewest assumptions should be selected.

Answer: A) Parsimony

Lex Parsimoniae (the law of parsimony) is a problem-solving principle that emphasizes simplicity in scientific modeling.

9. What is the primary role of an Institutional Review Board (IRB) in the method of scientific inquiry involving human subjects?

Answer: C) To protect the rights and welfare of participants by reviewing ethical considerations

IRBs are formal committees that review research protocols to ensure they meet ethical standards and do not cause undue harm to human participants.

10. A scientific 'Law' is a hypothesis that has been upgraded because it has been proven with 100% absolute certainty.

Answer: B) False

Name: _____ **Date:** _____

Scientific laws describe phenomena (often mathematically) under specific conditions, but they are not 'upgraded' hypotheses; theories explain 'why,' while laws describe 'what,' and both remain open to revision based on new evidence.