Name: _____ **Date:** _____

Epistemological Boundaries: Advanced Scientific Method Quiz for 12th Grade

Falsifiability, statistical significance, and peer review methodologies. Analyze the rigorous frameworks that separate robust empirical evidence from pseudoscience.

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1. In a longitudinal study examining the efficacy of a new CRISPR-Cas9 gene therapy, researchers fail to reject the null hypothesis ($p > 0.05$). What is the most rigorous scientific interpretation of this result?

A. The gene therapy is proven to be ineffective for the target condition.
B. The data does not provide sufficient evidence to support the treatment's efficacy.
C. The experimental design was flawed and produced a Type I error.
D. The hypothesis has been permanently falsified and cannot be retested.

2. Philosopher Karl Popper argued that for a theory to be considered truly scientific, it must possess the quality of _____, meaning it must be capable of being proven false by observation.

A. Verifiability
B. Reliability
C. Falsifiability
D. Reproducibility

3. A double-blind peer review process is primarily designed to mitigate cognitive biases, such as the halo effect or confirmation bias, within the scientific community.

A. True
B. False

4. When analyzing the results of a double-blind clinical trial for a new neuro-inhibitor, a researcher notices a 'Type II error.' What has occurred in the context of the scientific method?

A. The researcher accepted a false hypothesis (False Positive).
B. The researcher failed to detect a real effect that was present (False Negative).
C. The researcher used a non-randomized sampling method.
D. The researcher altered data to fit a preconceived theoretical framework.

5. In high-energy physics, such as the discovery of the Higgs Boson, a threshold of _____ sigma is required to claim a formal discovery, representing a 1 in 3.5 million chance of a fluke.

A. Two
B. Three
C. Five
D. Ten

6. In the hierarchy of scientific evidence, a meta-analysis of randomized controlled trials (RCTs) is generally considered to have higher evidentiary value than a singular observational case study.

A. True

B. False

7. Which of the following scenarios best illustrates the concept of 'serendipity' integrated with the formal scientific method?

A. A scientist follows a protocol perfectly and yields expected results.
B. A researcher accidentally contaminates a Petri dish, leading to the discovery of penicillin through rigorous follow-up.
C. An engineer builds a bridge based on established Newtonian mechanics.
D. A computer model predicts climate change patterns based on historical CO_2 data.

8. Thomas Kuhn's 'The Structure of Scientific Revolutions' suggests that science does not always progress linearly, but rather through _____, where an old model is replaced by a fundamentally different one.

A. Incrementalism
B. Paradigm shifts
C. Inductive reasoning
D. Theuristic leaps

9. If a researcher is studying the 'Leidenfrost Effect' and measures how droplet volume influences evaporation time on a surface at a constant 250°C, what is the 'controlled variable'?

A. The volume of the liquid droplets.
B. The time it takes for evaporation to occur.
C. The temperature of the surface.
D. The atmospheric pressure in the lab.

10. Inductive reasoning moves from specific observations to broad generalizations; however, it cannot provide absolute certainty in the same way that deductive reasoning can.

A. True
B. False