Name: _____ **Date:** _____

Answer Key: Nail the Lab: Advanced Inquiry and Design Strategies for Sophomores

Design controlled simulations and critiques of experimental variables to prepare for university-level research and peer review challenges.

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1. An environmental scientist observes that coral bleaching is more prevalent in areas with high agricultural runoff. To establish a causal relationship rather than a mere correlation, which action is most critical during the 'Experiment' phase?

Answer: B) Isolating nitrogen levels as the independent variable while holding temperature and light constant.

Establishing causality requires an experimental design where only the independent variable is manipulated while all other potential confounding variables are controlled.

2. In a study investigating the Haber-Bosch process, a chemist predicts that increasing pressure will shift the equilibrium toward ammonia production. This predictive statement, which must be falsifiable and grounded in Le Chatelier's Principle, is known as a(n) _____.

Answer: C) Hypothesis

A hypothesis is a testable, falsifiable prediction that provides a tentative explanation for a phenomenon based on existing scientific knowledge.

3. True or False: In advanced scientific inquiry, a 'null hypothesis' (H0) assumes that there is no significant statistical difference or relationship between the variables being tested.

Answer: A) True

The null hypothesis is a fundamental concept in statistical testing, serving as the default position that the effect being studied does not exist.

4. A team of researchers fails to replicate the results of a famous 2010 study on 'social priming.' According to the scientific method, what is the most appropriate next step for the scientific community?

Answer: C) Engage in peer review and further experimentation to determine variables that caused the discrepancy.

Science is self-correcting; replication failures lead to deeper investigation into experimental conditions, methodology, and the validity of the original hypothesis.

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5. When analyzing the results of a double-blind medical trial, the _____ group receives a sugar pill to ensure that observed effects are actually due to the medication and not participant expectation.

Answer: B) Control

The control group provides a baseline for comparison, allowing researchers to isolate the effects of the independent variable (the medication).

6. While investigating the Photoelectric Effect, Albert Einstein used 'thought experiments' to challenge existing Newtonian physics. This stage of the scientific method primarily involves which of the following?

Answer: B) Synthesizing theoretical frameworks to formulate new questions.

Advanced inquiry often involves the synthesis of prior research and theoretical logic to identify gaps in understanding before physical testing begins.

7. True or False: A scientific theory is a 'best guess' that becomes a scientific law once it has been proven true by enough experiments.

Answer: B) False

Theories and laws are different types of knowledge; laws describe 'what' happens (often mathematically), while theories provide the 'why' or the mechanism behind it.

8. If a biologist is studying the rate of enzyme activity at different temperatures, the measured reaction time is considered the _____ variable.

Answer: D) Dependent

The dependent variable is the factor being measured or observed; its value 'depends' on the changes made to the independent variable (temperature).

9. In the 'Communication' phase, why is it mandatory for scientists to describe their methodology in extreme detail?

Answer: B) To ensure the experiment can be replicated by independent parties to verify results.

Replicability is a cornerstone of the scientific method; findings are not accepted into the body of scientific knowledge until they are consistently reproduced by others.

10. True or False: If an experiment's data refutes the original hypothesis, the experiment is considered a failure and the data should be discarded.

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Answer: B) False

Refuting a hypothesis is a successful application of the scientific method, as it narrows down possibilities and leads to the formation of more accurate, refined hypotheses.