

The Scientific Method: A Chain-of-Thought Workflow

This document outlines the **eight sequential stages** of the Scientific Method, presented as a rigorous workflow. Each step is defined by a necessary logical progression—the "chain of thought"—that mandates the transition to the subsequent stage, ensuring objectivity and testability in the pursuit of actionable knowledge.

Step	Core Action	Chain of Thought (The Logical Driver)	Workflow Output
1	Observation & Question	<i>"Something anomalous, interesting, or necessary has been observed. Before proceeding, we must precisely define the ambiguity or gap in current knowledge to ensure the entire effort remains focused on a singular, solvable objective."</i>	A single, sharply defined, and answerable question (e.g., "Does variable X influence outcome Y?").
2	Background Research & Literature Review	<i>"Before investing resources into testing, we must ensure the question hasn't already been answered, and that we fully understand all relevant existing data, known biases, and methodologies used by others. This prevents unnecessary duplication and informs hypothesis design."</i>	A comprehensive summary of known variables, established theories, and critical gaps in literature.
3	Formulate a Testable Hypothesis	<i>"Based on the question and existing knowledge, we must now propose a specific, falsifiable statement that attempts to predict the outcome. If a prediction cannot be proven wrong (falsified), it is not a</i>	A Null Hypothesis (H ₀) and an Alternative Hypothesis (H _A). The H ₀ must state there is no effect/relationship.

Step	Core Action	Chain of Thought (The Logical Driver)	Workflow Output
		<i>scientific claim, and the next step (experimentation) is irrelevant."</i>	
4	Design the Experiment/Test Protocol	<i>"To accurately test the hypothesis, we must isolate the variables. This requires a precise plan to manipulate the Independent Variable (IV) while keeping all other Confounds (Control Variables) constant, and then objectively measuring the Dependent Variable (DV)."</i>	A detailed, repeatable protocol including materials, methods, control groups, and sample size justification.
5	Execute the Experiment & Collect Data	<i>"The protocol must be executed with meticulous rigor and objectivity. Any deviation from the plan introduces error and weakens the resulting conclusion. All measurements must be recorded accurately, systematically, and without subjective interpretation."</i>	Raw, quantitative and/or qualitative data sets, free of bias or preliminary analysis.
6	Analyze the Data & Interpret Results	<i>"Raw data alone is meaningless; we must apply the appropriate statistical and logical methods to convert observations into evidence. This allows us to quantify the likelihood that the observed results occurred by chance, informing the decision to either accept or reject the Null Hypothesis (H_0)."</i>	Statistical reports, graphs, tables, and a clear statement regarding the status of H_0 .

Step	Core Action	Chain of Thought (The Logical Driver)	Workflow Output
7	Formulate the Conclusion & Communicate	<i>"The analysis provides the final verdict: was the hypothesis supported, or must it be rejected? The conclusion must directly address the original question (Step 1), state the significance of the findings, and, crucially, acknowledge all limitations and sources of error."</i>	A formal report summarizing the process, findings, and the definitive conclusion relative to the hypothesis.
8	Iteration, Refinement, & Peer Review	<i>"Science is a cycle, not a endpoint. A supported hypothesis must be vetted and repeated by others (peer review) to validate reliability. A rejected hypothesis must trigger refinement of the model (Step 3) or the experiment (Step 4), leading back to a new iteration of the entire workflow."</i>	New or refined hypotheses, or confirmed, reproducible findings integrated into the collective knowledge base.

Key Principles of the Chain of Thought

1. **Falsifiability:** The entire workflow hinges on the hypothesis (Step 3) being *testable* and *falsifiable*. If the null hypothesis cannot be rejected, it still provides valuable information (i.e., the proposed relationship does not exist under the tested conditions).
2. **Objectivity:** Steps 5 and 6 demand maximum objectivity. Data collection and analysis must be isolated from the researcher's desired outcome to prevent confirmation bias.
3. **Reproducibility:** The ultimate goal of Step 4 (Design) and Step 8 (Iteration) is to ensure the entire process can be replicated by any competent party to achieve the same results, thereby establishing reliability.