An operational model for justification of scientific knowledge
Modified by Matt Ayres from work by Daniel A. Herms, Ohio State University

Observations and Question
Discovery, previous experimental result, detection of pattern – leads to new question regarding the structure/function of nature

Theoretical model
Mechanistic explanation; potential answer to question.

Theoretical hypothesis
Statement that a particular conforms to the theoretical model

Prediction (Hypothesis)
Deduced from and used to test theoretical model. Deducible: If the predicted result does not occur, the model must be false. Improbable: Unlikely to be observed if the theoretical model is false.

Logical hypothesis (LH) (statement of prediction) vs. Logical null hypothesis (LNH) (statement of all alternatives)

Tests of LH vs. LNH often employ a Statistical hypothesis (but two possible cases):

Case 1: LNH = SNH (statistical null hypothesis); most common
Case 2: LNH ≠ SNH

Hypothesis test
Controlled experiment or pattern detection or observation
Objective: reject or support LH

Prediction True.
Data consistent with theoretical model.
LH supported with certainty ≈:
1-P if LNH = SNH (Type I error);
Power if LNH ≠ SNH (Type II error);

If LNH=SNH, inductive justifying argument for theoretical model supported by (strong) deductive refuting argument from statistics.

Prediction False.
Data do not support theoretical model.
LH refuted with certainty ≈:
Power if LNH = SNH (Type II error);
1-P if LNH ≠ SNH (Type I error);