

Explanation: a scientific explanation of an event or regularity is an argument that purports to demonstrate why the event or regularity came to pass, given other features of the world. Why was the outcome necessary or probable in the circumstances and in the presence of relevant governing laws or regularities? The most general model of a scientific explanation is that of a “covering-law explanation.” A covering-law explanation is an argument consisting of one or more general laws, one or more particular statements (boundary conditions), and deductive derivation of a statement of the phenomenon to be explained (the explanandum). Such explanations are designed to show why the outcome was necessary in the circumstances, given the initial conditions and the laws of nature. A covering-law explanation subsumes the phenomenon under the general laws. A probabilistic explanation has a similar logic. Probabilistic explanations identify one or more statistical laws and subsume the phenomenon under these laws: given probabilistic laws L_i , the probability of O is P. These approaches to the logic of scientific explanation give primacy to the role of scientific laws or laws of nature in explanation. On this approach, we have explained an outcome when we have shown how it is necessary (or probable), given the relevant laws of nature. A different approach to scientific explanation proceeds from the point of view that the world is a system of causal processes and mechanisms. On this approach, we have explained an outcome when we have provided an account of the causal mechanisms and powers that led to the occurrence of the outcome. Causal explanations proceed by identifying causal mechanisms through which the initial conditions brought about the explanandum. The two approaches are related, since the presence of causal mechanisms also implies the availability of lawlike generalizations that can function within covering-law explanations. But the causal mechanism approach comes closer to the intellectual task of scientific explanation. We want to know why the event occurred when we ask for an explanation of an outcome. Ptolemy’s explanation of the observed locations of the planets in the heavens proceeded on the basis of subsumption of planetary motion under a set of lawlike generalizations (cycles and epicycles). But the explanation was unsatisfactory because it rested upon a false conception of the causal processes that resulted in astronomical observations (geocentric rather than heliocentric motion of the planets).

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