Summarize result (100%) What does it mean to think scientifically? We might label a preschooler's curious question, a high school student's answer on a physics exam, and scientists' progress in mapping the human genome as instances of scientific thinking. But if we are to classify such disparate phenomena under a single heading, it is essential that we specify what it is that they have in common. Alternatively, we might define scientific thinking narrowly, as a specific reasoning strategy (such as the control of variables strategy that has dominated research on the development of scientific thinking), or as the thinking characteristic of a narrow population (scientific thinking is what scientists do). But to do so is to seriously limit the interest and significance the phenomenon holds. This chapter begins, then, with an attempt to define scientific thinking in an inclusive way that encompasses not only the preceding examples, but numerous other instances of thinking, including many not typically associated with science. What is Scientific Thinking and Reasoning? There are two kinds of thinking we call "scientific." The first, and most obvious, is thinking about the content of science. People are engaged in scientific thinking when they are reasoning about such entities and processes as force, mass, energy, equilibrium, magnetism, atoms, photosynthesis, radiation, geology, or astrophysics (and, of course, cognitive psychology!). The second kind of scientific thinking includes the set of reasoning processes that permeate the field of science: induction, deduction, experimental design, causal reasoning, concept formation, hypothesis testing, and so on. Definition of Scientific Thinking Scientific thinking is the conscious synthesis of facts or data used to reach a meaningful term that produces something that makes sense. It focuses on answers to "why" and "how" questions. Productivity of something serves as a result of scientific thinking. All scientists are proof the mind is composed of scientific thinking. Scientific discoveries are the result of scientific thinking strategies. Production of information and communication, technology and machines are all examples that serve as outputs to scientific thinking. Galileo Galilei, Albert Einstein, Newton, C. V. Raman, and Aryabhata all became well-known scientists through their scientific thinking and restless experimenting approaches. The definition of scientific thinking adopted in this chapter is knowledge-seeking. This definition encompasses any instance of purposeful thinking that has the objective of enhancing the seeker's knowledge. One consequence that follows from this definition is that scientific thinking is something people do, not something they have. The latter we will refer to as scientific understanding. When conditions are favorable, the process of scientific thinking may lead to scientific understanding as its product. Indeed, it is the desire for scientific understanding -- for explanation -- that drives the process of scientific thinking. Scientific thinking is a type of knowledge seeking involving intentional information seeking, including asking questions, testing hypotheses, making observations, recognizing patterns, and making inferences. Much research indicates that children engage in this information-seeking process very early on through questioning behaviors and exploration. In fact, children are quite capable and effective in gathering needed information through their questions, and can reason about the effectiveness of questions, use probabilistic information to guide their questioning, and evaluate who they should question to get information, among other related skills. Although formal educational contexts typically give students questions to explore or steps to follow to "do science," young children's scientific thinking is driven by natural curiosity about the world around them, and the desire to understand it and generate their own questions about the world. Scientific thinking refers to both thinking about the content of science and the set of reasoning processes that permeate the field of science: induction, deduction, experimental design, causal reasoning, concept formation, hypothesis testing, and so on. 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The relationship of the principles, and theories led to the conclusions of the study. 4) The argument: A discussion of the reliable or accurate reasons of the learners. When we have information from reliable experiments, we just need a friend to confirm our confidence in what we describe. The message shows that learners are able to explain why and indicate that the source and reliability of such reasons. Scientific Thinking in Children Well before their first birthday, children appear to know several fundamental facts about the physical world. For example, studies with infants show that they behave as if they understand that solid objects endure over time (e.g., they don't just disappear and reappear, they cannot move through each other, and they move as a result of collisions with other solid objects or the force of gravity. And even 6-month-olds are able to predict the future location of a moving object that they are attempting to grasp. 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A recent comprehensive review of what children bring to their science classes offers the following concise summary of the extensive developmental and educational research literature on children's scientific thinking: • Children entering school already have substantial knowledge of the natural world, much of which is implicit. • What children are capable of at a particular age is the result of a complex interplay among maturation, experience, and instruction. What is developmentally appropriate is not a simple function of age or grade, but rather is largely contingent on children's prior opportunities to learn. • Students' knowledge and experience play a critical role in their science learning, influencing four aspects of science understanding, including (a) knowing, using, and interpreting scientific explanations of the natural world; (b) generating and evaluating scientific evidence and explanations, (c) understanding how scientific knowledge is developed in the scientific community, and (d) participating in scientific practices and discourse. • Students learn science by actively engaging in the practices of science. In the previous section of this article we discussed conceptual change with respect to scientific fields and undergraduate science students. However, the idea that children undergo radical conceptual change in which old "theories" need to be overthrown and reorganized has been a central topic in understanding changes in scientific thinking in both children and across the life span. This radical conceptual change is thought to be necessary for acquiring many new concepts in physics and is regarded as the major source of difficulty for students. The factors that are at the root of this conceptual shift view have been difficult to determine, although there have been a number of studies in cognitive development, in the history of science, and in physics education that give detailed accounts of the changes in knowledge representation that occur while people switch from one way of representing scientific knowledge to another.Summarize result (100%) What does it mean to think scientifically? 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