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Lessons from the history of the concept of the ray for teaching geometrical optics.

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Summary: There are two indisputable findings in science education research. First, students go to school with some intuitive beliefs about the natural world and physical phenomena that pose an obstacle to the learning of formal science. Second, these beliefs result from the confluence of two factors, namely, their everyday experience as they interact with the world around them and a set of operational constraints or principles that channel both perceptually and conceptually the way these experiences are perceived and interpreted. History of science suggests that the theories of early scientists through which they sought to explain physical phenomena relied mostly on ideas that closely fitted their experiences of the relevant phenomena. This characteristic of the early scientific ideas is the root of the epistemological difficulties that early scientists faced in their attempts to explain the phenomena. In this paper, we focus on the early theories in optics (from ancient Greek to the late Islamic scientific traditions) and argue that students face some of the same epistemological problems as early scientists in explaining vision and optical phenomena for the reason that students' intuitive beliefs are also closely tied to particular phenomena and as a result the underlying notions are fragmentary and lack the necessary generality that would allow them to cover many disparate phenomena. Knowledge of these epistemological problems can help the instructor to identify the key elements for a better understanding of the formal theory of optics and, in turn, lead to a more effective instruction.

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