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Student resources for learning physics

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Careful observations of learners' reasoning belie simple characterizations of their knowledge or abilities: Students who appear to lack understanding or abilities at one moment show evidence of them at another. Detecting this variability generally requires close examination of what and how students are thinking, moment-to-moment, which makes research difficult. But the findings challenge unitary accounts of intelligence, stages of development, and misconceptions. Joe Redish and others have been working from a more complex theoretical framework of innumerable, fine-grained cognitive structures we call "resources." They are, roughly, ways of thinking people have that may apply or not in any particular moment. (Thinking about energy, for example, may involve resources for understanding location or conservation, or oscillations in time, or differential symmetry.) The variability we observe in student reasoning reflects variability in resource activation. Resources are to models of mind what *partons* used to be to models of hadrons: We know we should be thinking of entities and dynamics at a smaller scale than we've been considering, even if we don't know their particular properties. Understanding minds in this way has profound implications for research and for teaching.