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Physics of Toys: The Joy of Asking Questions

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Children are natural scientists. They ask questions, they observe, they try things to see what happens. Often school-based science does little to nurture the young scientist and, in fact, may do just the opposite with thick textbooks, fact heavy lessons, and too many equations. The exploration of common toys produces deep learning by emphasizing concepts and connections before formal definitions and mathematics. It also connects the classroom to the familiar world outside of school and gets students writing and talking about physics ideas. At the university level, investigating what toys do and how they do it can be a challenging application of undergraduate physics from the introductory course up through senior mechanics. Toys provide an ideal system for the kind of open-ended inquiry that introduces students to what scientists really do. They can pose their own questions, explore the behavior of the system sufficiently to create a hypothesis, use their theoretical knowledge to make a simplified model of the system and predict an outcome, design an experiment, discover that the real world is messy, think about what they haven't taken into account with their simple model and try to improve it. I have spent close to 30 years thinking about how to use toys to enhance physics education from 4th grade through college. In the process I have collected hundreds of toys the majority of which relate to mechanics, but also to sound, light, electricity and magnetism. I will discuss the pedagogical reasons for using toys in physics education and the many different ways to use them from demonstrations to laboratory experiments to discussion starters as well as how it is possible to use the same toy with many different age levels by approaching the analysis differently. I will share a number of my favorite toys, but focus particularly on those related to energy concepts.