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Making Introductory Quantum Mechanics Intuitive and Relevant

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The standard treatment of introductory quantum mechanics presents it as a series of miraculous and incomprehensible insights and theories that leaves most students convinced that the subject is fundamentally incomprehensible to mortals such as themselves. I have developed a course based explicitly on QM as the logical and understandable incremental process of the development of models to explain experimental phenomena. This uses a somewhat sanitized historical perspective, where the relevant experimental data is presented, then students see how a model was created to explain the observations and the context in which it was used and tested, and how its failure to explain new data leads to the development of an improved model. We proceed through the photoelectric model of particle-wave duality, followed by the Bohr, De Broglie, Schrodinger, Schrodinger plus radiative transitions models of atoms. This course is heavily supported by PhET interactive simulations which simulate the critical experiments and model predictions in particularly educationally helpful formats. I also show how this basic QM underpins many phenomena in the world around us, such as the detection of light by eyes and photodetectors, the colors of objects, varying resistivity of materials, semiconductors, diodes, lights, and lasers, etc. Our data show that students gain a better understanding and appreciation of QM concepts from this course compared to the standard treatment, and a much greater confidence that these ideas are things they can understand. I will also briefly discuss our recent advances in understanding expert problem solving in physics (and other sciences and engineering) in terms of a universal set of ˜30 decisions-to-be-made and the predictive frameworks that guide those decisions.