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Designing a course to prepare secondary mathematics and science teachers that truly integrates STEM was both the goal of our team (chemist, biologist and mathematician) and a monumental challenge. Throughout the design and revision process we found ourselves struggling to develop authentic problems, transform closed mindsets, and balance varying abilities in mathematics, science and engineering. Once we began understanding the similarities in scientific inquiry, mathematical problem solving and the engineering practices, we were able to design a well-developed course that allows scientists to see the value in using mathematics to make better decisions, mathematicians the value of true scientific inquiry, and engineers the value of scientific exploration combined with mathematical precision to provide the best results to problems. This paper takes a look at the challenges and triumphs associated with developing and executing a truly integrated STEM course. (Received September 15, 2020)