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With the assistance of a grant from the National Science Foundation, our Department is integrating computer algebra systems into the introductory undergraduate course in abstract algebra and an advanced undergraduate course in linear algebra. Using GAP, Group Analyzer, and Maple, we have developed computer activities for several topics, including structure theorems for groups, primes and divisibility in rings, canonical forms of matrices, and elementary Galois theory. Proofs play a significant role in these courses, which are taken not only by undergraduates, but also by some first-year graduate students, and it is therefore important for us to utilize computer algebra systems in ways that support, rather than undermine, their theoretical focus. In this paper we will discuss some of these computer activities in detail and give references where others can be found. We will describe the pedagogical context for these assignments and activities and the ways in which they can help students to develop a rich understanding of the theoretical aspects of abstract and linear algebra. Finally, we will share our experiences in teaching graduate courses in abstract algebra to students who have learned undergraduate algebra in this way. (Received September 15, 2000)