A study of the vibrational spectra of cis- and trans-1,2-dichloroethylene provides an excellent way for undergraduates to gain experience with the application of group theory in the physical chemistry laboratory. Although the group vibrations are similar for these two molecules, the selection rules for infrared (IR) and Raman spectra differ significantly. Most of the transitions for the fundamentals of the cis isomer of \( C_{2v} \) symmetry are both IR and Raman active. Mutual exclusion for the vibrational transitions applies to the centrosymmetric trans isomer of \( C_{2h} \) symmetry. Thus, half the transitions for the trans isomer are IR active and half are Raman active. The two isomers are volatile enough that gas-phase IR spectra can be recorded at room temperature. Band shapes in gas-phase IR spectra provide additional evidence for assignments of fundamentals. The two isomers are small enough that good quality quantum chemical calculations of harmonic frequencies can be done by students with commercial software.