We explain how deformation theory and other algebro-geometric methods are used to study the problem of irreducible specialization for one-variable polynomials with coefficients in the coordinate ring of a smooth affine curve (with one geometric point at infinity) over a finite field. We establish a higher-genus version of the periodicity theorems discussed in the genus-0 case in my colloquium talk this week, at least in odd characteristic, and we pose some thorny questions in the vexing case of characteristic 2.