We will discuss recent work on incremental online Bayesian learning based on the development of a locally weighted projection regression (LWPR) method for modeling data in high dimensions. Under the assumption of locally low-dimensional distribution of the problem, LWPR finds efficient local projections and approximates the local model using classical locally weighted learning (LWL) algorithms. LWPR has linear computational complexity in the number of inputs, and could handle data sets with high dimensionality. We demonstrate the method to the solution of SPDEs in high-dimensions and provide comparison with sparse grid collocation methods.