Layer-by-Layer (LbL) assembly of oppositely charged polyelectrolytes (PE) involves a complicated set of physical processes. Despite the numerous applications of PE multilayer films (PEM), there is still no quantitative model that describes salient features of this process such as chain complexation, and diffusion of polyions, salts, and water, as functions of time and position in the film during deposition and rinsing. Previous models are either only thermodynamic in nature or otherwise based on severe assumptions about dynamics and thus fail to predict some of experimentally observed trends. A continuum description of LbL assembly, accounting for PE chain diffusion, complexation, network relaxation is reported here. By formulating the model as a moving boundary problem, the height of the PEM can be continuously tracked over time. PE complexation is incorporated into model by considering the ion pairing reactions whereby repeat units of oppositely charged PEs lose their counterions to join the PEM. Using a combination of Flory-Huggins and Flory-Rehner free energy model and Poisson equation to solve for the electrostatic potential profiles, we observe that diffusion of PE chains even into a neutral PEM network is markedly different from diffusion of neutral polymers into a network. As PE chains diffuse, counterions readjust themselves to minimize the net local charge, but fail to do so completely as they would have to pay a significant entropic penalty. Diffusion of PE chains predominantly driven by the electrostatic field induced by the entropy of counterions is characterized by pulse-like PE composition profiles. Even without considering chain complexation, we demonstrate that it is possible to at least qualitatively explain the non-monotonic variation of PEM growth kinetics versus salt concentration, observed experimentally.