Undergraduate research experiences (UREs) are a vetted educational tool that is commonly perceived to prepare students for entering graduate school and careers in STEM fields. Despite the merit of prior literature in providing evidence to the effectiveness of UREs in augmenting participant skills, research to date has largely relied on self-report data, which may limit inferences about the causal effects of these experiences on student outcomes. In an effort to improve the fidelity of research investigating the effect of UREs on learning, the present study complimented self-report data with performance measures to assess the development of student researchers’ scientific thinking skills. To evaluate skill changes related to experimental problem solving and data analysis, a performance instrument using open-response tasks situated in scientific problems and associated scoring criteria was designed and tested. Content and construct validity of the instrument was established through an iterative recursive design process involving experts in science content and pedagogy. In summer 2013, longitudinal performance data were collected from chemistry URE participants (n=24) at seven colleges and universities over the course of a research experience. Results of the study demonstrate the instrument to be a highly reliable assessment tool for providing insight into URE participants’ levels of scientific thinking, and how skill proficiencies change throughout a research experience. As well, these data demonstrate participants made significant improvements in their problem solving and data analysis abilities over the course of their URE as well as identified potential gaps in student skill. These results indicate that URE participation can substantially contribute to important science thinking skills. This exploratory work begins to fill a void in the literature by providing actual performance data to the effect of UREs on student learning, which may be of particular interest to faculty and administrators for the refinement of UREs to improve student training.