Hydrology is similar to other Earth science sub-disciplines in that understanding many of its key concepts requires a sound supporting-science conceptual framework. The Geoscience Concept Inventory (GCI) is an assessment instrument for measuring learning that includes questions from most geologic sub-disciplines, including hydrology. Nationwide pre- and post-testing of introductory Earth science courses with the Geoscience Concept Inventory show little gain for many of its questions. Analysis of matched tests shows that students are typically switching between wrong answers. Of the 22 GCI questions that showed a normalized gain of <0.03, 9 covered basic physics and chemistry principles. Half of the low gain questions had change rates within 20 percentage points of that expected for guessing, indicating that students have high conceptual mobility. These results also pertain to the high pre-test students, suggesting that little conceptual entrenchment occurs for many students enrolled in entry-level courses. We suggest that students may have difficulty settling on a correct hydrological or geological conception because of the shaky supporting-science underpinnings upon which these ideas are built. These results prompt the following questions; when do our hydrology and other Earth science students learn fundamental science concepts, and what role does an introductory course play in this learning? We suggest that longitudinal studies are needed for time periods longer than a semester, and that more attention be paid to when conceptual change occurs for our advanced learners.