# The Story of Ice:
## Design of a Virtual and Augmented Reality Field Trip Through Yosemite National Park

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## EXECUTIVE SUMMARY

*Increasing enrollment and costs in introductory geoscience classes are making the logistics of organizing on-location field trips challenging; but with modern technology, virtual field trips (VFTs) can provide a proxy. Students entering college today are digital natives with short attention spans, suggesting they would find a VFT appealing and easy to navigate. While not a replacement for an actual field trip, VTFs offer interactive alternatives to traditional lectures, and several have been successful in engaging and educating students. This proposed VFT utilizes the iconic geology of Yosemite National Park to teach the effects of climate change at geologic and anthropogenic timescales. The story is told along Yosemite's four roads and is designed for use as a roadside geology accompaniment in the park, or as a standalone interactive tool in the classroom. VFT stops narrate the geologic history of the area and use photos with illustrated overlays to further describe concepts.*

## INTRODUCTION

The benefit of field trips for teaching geology is undeniable and such trips have long been considered the carrot that attracts students to this field. However, growing class sizes and high costs make the logistics of organizing a traditional, on-location field trip challenging. This situation has resulted in educators exploring the concept, use and benefits of virtual field trips (VFTs) and augmented reality field trips (ARFTs). VFTs and ARFTs allow students to learn concepts that would be taught on a traditional field trip without the logistical and financial challenges of bringing a large class out into the field. In addition, VFTs and ARFTs can provide field trip opportunities to students who would have none due to lack of

funding, geographic location, and physical or mental disabilities (Stainfield, J., Fisher, P., Ford, B., & Solem, M., 2000). These digital tools are interactive and function on the students' smartphones. Bringing the natural world to these smartphones can provide a proxy for a traditional on-location field trip.

There is a new generation of students entering college: they are digital natives who are connected 24/7 to their mobile smart devices (Knight, 2009). These tech-savvy millennials would likely have no issues or complaints about using a well-designed VFT or ARFT as a tool in their undergraduate education. A VFT involves using a digital device to teach students about a location where digital imagery replicates a real environment, or computer graphics are used to create an imaginary environment. An ARFT uses the real world for some aspect of teaching and learning with elements augmented or supplemented by digital imagery. In both cases, the digital tool the students use and interact with for their VFT or ARFT experience is considered a smart learning environment (SLE). The delivery of a VFT or ARFT via a smartphone or tablet effectively is an SLE by giving the learner control over the rate of information delivery, thereby providing individualized learning in an efficient and engaging manner.

National Parks contain spectacular landforms that are ideal for teaching many topics in geology. However, they are not readily accessible for field trips for an average college student in an introductory class or for a casual day visit even by the general population. Furthermore, lower division introductory geoscience courses are typically taught in the form of a lecture with a complementary lab, not necessarily required to be taken concurrently. In recent years, consideration of gender issues, perception of danger, language barriers, logistical and preparation problems, culture shock and the need to assess risks, have made field trips difficult to organize (Stainfield et al., 2000). By merging the natural wonders of our National Parks with virtual and augmented reality technologies, educators can tackle the many feasibility issues of providing field experiences to students in high enrollment introductory courses. Adding variety in the form of VFT or ARFT SLEs to these typical lecture-based courses will also allow instructors to keep their students more engaged.

Yosemite is one of the most visited National Parks in the National Parks System. In 2016, over 5 million visitors came to see the roaring waterfalls, looming granite cliffs and sequoia groves that inspired early European-American explorers and paved the way for the establishment of the National Parks System (National Park Service, 2017). Among the picturesque Yosemite landmarks are examples of glacial features: u-shaped valleys, hanging valleys, moraines, erratics, roches moutounneé, kettle ponds and lakes. Additionally, receding glaciers and snowpack within the park can also show the impact of human-timescale climate change.

In this study, we will discuss previous research and findings on VFTs and ARFTs in the field of science education, and use this background as justification for our proposed new VFT through Yosemite National Park (YNP). Very few of these types of tools exist, and even less research has been done on their validity in introductory post-secondary education physical science courses, let alone geology. Furthermore, the use and evaluation of this type of tool in public informal education in National Parks has never been done. Production on the Yosemite VFT is expected to begin in 2018 and pilot testing will begin as prototypes are created. Our proposed new VFT showcases the iconic features of YNP and uses them to educate students and public park visitors about the glacial history of Yosemite and the impact of recent climate change on the landscape of the park.