



# A Three-Dimensional, Virtual Tour of the Johnston Geology Museum

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As a need for online communication grows, digital 3D models provide an effective strategy for teaching shape- and orientation-based concepts that are essential for understanding geology. While developing our department's first, all-online section of an introductory earth-science class, we created a low-cost, 3D, virtual tour that simulates a traditional, on-campus visit to our University's geology museum. When combined with 360° images, the tour allows both traditional and online museum visitors to view mineral, rock, and fossil samples on cell phones, tablets, or computers. The new approach extends the use of an established museum assignment that is regularly used in our introductory face-to-face geology classes to our online students. Digital rotation and magnification of samples encourages in-depth examination of the specimens and materials that is not possible when looking through glass displays, enriching the museum experience for both online and traditional museum visitors. The new approach also provides audio tracks and alternative viewing access for differently abled or small museum patrons and expands the museum's visibility to a broader online audience.

## MATERIALS AND METHODS

The Johnston Geology Museum features rocks, fossils, mining history, and Native American artifacts of relevance in Kansas. Used by both the university and a regional public audience, it has hosted thousands of open houses and school and scout field trips, in addition to supporting our earth-science curriculum. The collection is organized in display cases and as free-standing specimens that are accompanied by maps, drawings, and written explanations. We created virtual displays of ten cases using 3D modeling software (Agisoft, 2018) that aligns, masks, and renders multiple digital photos into clusters that form the basis of our

models. Individual specimen models were generated from 30 to 200 digital photographs, while entire display cases required five to 10 photos, for smaller cases, and up to 150 photos for the large displays. Photos were taken at 18 megapixel resolution using a standard digital SLR camera. The rendered model files were edited and viewed using a commercially available viewer on a public-access server (Sketchfab, 2018). Three-dimensional subjects can be rotated, enlarged, and navigated using a mouse or two-finger swipes on a computer, tablet, or cell phone. Software used to create the models costs US\$15 to US\$550 (depending on license type), and the 3D viewer may be accessed for free or at a minimal cost. Our online virtual tour can be viewed for free wherever the Internet is available.

The virtual museum exercise begins with a 360° photograph of the museum. Ten "stops" (Fig. 1) along the tour include clickable links that provide access to 3D models of individual specimens, and expanded dialog boxes containing relevant background and explanations. Because most students in our introductory geology classes are not earth-science majors, and many museum visitors have minimal science background, we took advantage of an opportunity to amend the physical displays with digital materials of relevance to our exercise by adding links to new content. Additional explanations of plant and animal life modes, environmental conditions, and geologic time help to clarify concepts emphasized in our class through links to relevant short videos, location maps, and updated geologic time scales. The option of adding new questions and advanced material would allow for use of the 3D images in our upper-level geology courses. Students were able to complete the introductory virtual tour assignment in one to two hours.

## OUTCOMES AND APPLICATIONS

After two semesters of its use, we have observed several positive outcomes and one limitation of the virtual experience. Online students scored higher than traditional students on exercise questions about fossil preservation and life modes, probably owing to the superior viewing angles and in-depth examination of subtle details that were possible when viewing the 3D models. By revising the original exercise so that the oldest fossils are visited first, and embedding links to a geologic time scale at various places within the exercise, we noted more thoughtful answers to questions about important events in earth history. Links to images or videos of modern environmental analogues helped allow students who have not traveled extensively beyond the Midwestern United States to better visualize the landscapes and environments of ancient Kansas. Because our assignment features only select display cases, the discovery that takes place when casually browsing an entire museum is lost; many valuable exhibits that are not part of our tour can only be accessed through a face-to-face visit.

The use of 3D models is emerging in the growing field of online geoscience education (e.g., Brande and McDaniel, 2018; Nesbit et al., 2020). Our exercise is the first to combine a virtual museum tour with 3D models that illustrate the geologic history of Kansas. The tour provides access to mid-continent geologic history that may not otherwise be available to students and geologists living outside of our region. The potential use of our exercise in online secondary education teaching may help teachers communicate earth history concepts to a younger audience and inspire future earth-science majors.

To take a 3D tour of the Johnston Geology Museum visit <https://sites.google.com/view/>

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Cretaceous Fossils of Western Kansas [Cases 1-7]

**Figure 1. Stop 7—The Cretaceous Fossils of Kansas.** The 3D display (A) is superimposed on a map of the Cretaceous Seaway, which is visible when the model is open. Explanations (B), videos, enlarged images, and audio tracks are linked to special display features as circled numbers.



### Cretaceous Kansas Geology

The Cretaceous rocks in Kansas are confined to the western half of the State and reach a maximum thickness of 3000 feet in the northwest corner. Throughout most of the western one-fourth of the State it is buried below the younger Ogallala formation of Tertiary age. This leaves a band about four counties wide of exposed Cretaceous which trends from the north central through the west central part of the State. The Cretaceous is subdivided into the Gulfian or Upper Cretaceous and the Commanchean or Lower Cretaceous. The Gulfian consists of several layers of marine deposits including the chalk layers for which the Cretaceous is famous. The thickest of these is the Niobrara Formation which has an average thickness of 600 feet. It is exposed along an irregular band immediately to the east of the High Plains. A long narrow belt of exposed Niobrara follows the valley of the

schulmeister-hydrogeology/virtual-tour-of-the-johnston-geology-museum, or scan the QR code provided below.



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