Application for TLEF Project Funding —Trilobite Learning Center

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Abstract

Proposed herein is a learning center based on the extensive University of Alberta trilobite collection, which was collected by Emeritus Professor Brian Chatterton and his students. The collection narrates more than 290 million years of evolutionary history and provides a long-term teaching asset to be used in the education in evolution, ancient ecosystems, animal classification and advanced paleontological studies. The facility is aimed to support course-work in existing classes, undergraduate research, and blended learning initiatives. The facility is proposed to adjoin the existing Paleontology Museum housed in the Earth Science Building. Three-dimensional up-scaled models of trilobites will permit handling and comparison of high-quality replicas of key specimens selected for their scientific importance. Cabinets and interactive displays would be used to link the collection to exceptional examples of evolutionary theory, the history of life and the concepts central to a number of courses in science.

Project Description

Figure 1: Trilobites are among the most well known types of fossils. These animals showed great diversity in their size, ornamentation of their armour, head and tail shapes (some of which truly are outrageous), and eye shape. The above example has turreted eyes that aided the animal in achieving near 360 degrees of vision!

Museum collections are often perceived as a means of preserving valuable and unique specimens and material. However, if the only function of a collection is preservation, then the mission of

that collection has not truly been fulfilled. Collections are meant to be used – to move research forward in the hands of scientists and students, to serve as educational examples to future scientists, and to be a focus for public outreach. This is especially true when a collection is based on material that is intrinsically captivating to students and which readily captures the imagination of the public. With this principle in mind, we are requesting funding to support the development of the Brian Chatterton Trilobite Learning Center at the University of Alberta.

Over the course of his distinguished career, Dr. Brian Chatterton, Professor Emeritus, acquired an extraordinary collection of trilobites (Figure 1 – one of the more surreal trilobites). This collection includes over 10,000 specimens, from eleven countries, representing the complete time range of trilobites (~540 to 250 million years ago). The collection is especially strong in specimens from western and northern Canada, and is one of the largest university trilobite collections in the world. The material also includes the type material – the published scientific exemplars – for over 250 new species.

Trilobites were an early marine member of the phylum Arthropoda, the group of organisms that includes insects, spiders, millipedes, crabs, barnacles, among many others. Arthropods are far and away the most diverse and abundant animals on the planet, and they have been imperative contributors to ecosystems from the Cambrian to the present. Unfortunately, most arthropods do not preserve well, therefore they are *missing* from the fossil record, thus we know relatively little about their evolution and ecology. Trilobites are an important exception: they have an excellent fossil record, and the University of Alberta trilobite collection is remarkable. The specimens are outstanding in their preservation and detail (Fig. 1). Moreover, because trilobites have many readily identifiable and distinguishable features (compared to other fossils such as clams or corals for example) – they are particularly suitable for evolutionary learning and research on shape change. Given the size and diversity of the Chatterton Collection, there is a tremendous amount of valuable research that should still be investigated. It is an excellent collection to be used by both University of Alberta students and scientists, as well as for the public at large.

The greatest value of the trilobite collection is its potential for education. Like most arthropods, trilobites appeal to people – they are unusual enough to be unique and exciting, whilst similar enough in appearance to modern arthropods to be recognizable. Trilobites are popular – what other invertebrate is regularly sold as a stuffed animal toy at museums? Or have been the focal point of multiple coffee-table books? There is also a thriving market of trilobite specimens on eBay – if the trilobite collection were sold at public auction, it would be minimally worth over $1,000,000. When the public comes to a museum exhibit, already intrigued by the subject, it is far easier to teach them, not only about trilobites, but also about broader topics such as evolution, ecology and extinction. The University of Alberta has a rare opportunity – this material is already collected and housed here – and we need to take advantage of this extraordinary collection. This is not material that should wind up buried in the depths of cabinets in remote storage. This is material that needs to be displayed and regularly used in science education.

The main purpose of the Trilobite Learning Center will be to educate university students on a range of topics including evolution, mass-extinctions, ancient ecosystems and the classification of animals. Using interpretive displays and 3-D printed models of trilobites, students will be provided with a broad range of exercises that will help them interrogate these fascinating topics.

Because a basic purpose of the facility is to provide a background in invertebrate fossil studies, the facility will support lab components of junior-level undergraduate courses. EAS 105 (The Dynamic Earth Through Time), for example, would use the facility to illustrate changes in fossil distribution over time, which is a fundamental aspect of the geological sciences known as Biostratigraphy. The more advanced EAS 230 (Introduction to Invertebrate Paleontology) and PALEO 414 (Paleontology) would use the facility to support lecture materials and lab work that centers on the topics mentioned above.

At the fourth-year level, the study of invertebrate-animal fossils focuses more on the study of ancient animal communities and their interactions. Again, the proposed learning center would provide key centerpieces to highlight the changes in trilobite morphology and community structure over time, with the aim of directing students learning into sophisticated evolutionary principles that cannot be fully explored without the breadth of fossil material that the trilobite collection offers. At this level, the potential of the collection for experiential learning and undergraduate research initiatives (e.g. Honours Theses) is truly vast. Students engaged in hands-on investigation would learn many essential skills including, but not restricted to: reference research, classification of animals, fossil preparation, digital photography techniques and post-processing, figure and map production, geographic and geologic knowledge of the study area, and manuscript preparation, all whilst forming hypotheses that pertain to Evolution, Extinctions and Ecology.

A long-term goal of the facility will be to encourage the development of new courses and learning opportunities. A set of new courses or course topics that we envisage includes:

1. Applied Systematics: a course on the classification of fossil animals.
2. Ontogeny and Phylogeny: focus on life-cycles of trilobites through time and the relation to critical evolutionary developments through time.
3. Form and Function: how to analyze animal shape and how shape relates to the animal's function and performance.
4. Fossil Preparation: hands-on course with presentations, term papers and demonstrated understanding of preparation of fossil materials.
5. Marketing paleontology: a 1 credit course which considers finance, marketing, and promotion of fossil material, in addition to writing research proposals and letters to potential donors.

Most importantly, with the presence of the abundant specimens and their availability, the courses above could be presented in blended learning styles that would include classroom discussion, scrutiny of museum specimens, links to online knowledge and integration with other studies in paleontology.

Project Impact

The completion of this project would have an impact on university students, scientists, and the public (K- grade 12, and adults). At completion, over 1500 undergraduates enrolled in the Departments of Earth and Atmospheric Sciences and Biological Sciences will use the collection,

displays and activities annually. The courses range from junior to graduate level. Art & Design may use the collection, exhibits and activities to achieve current and future learning outcomes in courses from first year to graduate. Undergraduate student research opportunities in advanced paleontology would increase substantially. Presently, up to five thousand public visitors in self-guided and guided programs and summer camps interact with the displays. This number is expected grow. The project is innovative in the use of one well known group of fossils to explore a variety of complex topics, the development of diverse learning opportunities using a University of Alberta collection, the production and of digital and physical 3D models to aid in experiential and blended learning activities, and the enhancement of public outreach. This project is a rare opportunity for the University of Alberta's TLEF to engage the community in the development and evaluation of a project.

Project Evaluation and Dissemination

Consultation is required to develop displays and activities suitable to engage a wide range of visitors from experts to the public. Surveys that have ethics approval will be used to consult instructors in Earth & Atmospheric Sciences, Biological Sciences, Education, and Art & Design, as well as grade-school educators, before and after the project. Results of the pre-project survey will be used to inform exhibit and activity development. Results of the post-project survey will inform the department of its successes and opportunities for improvement. The results of the project will be shared with the university community through the Festival of Teaching, to the museums community as a written or oral presentation hosted by the Alberta Museums Association, and in a submission for publication to the peer reviewed journal "Journal of Geoscience Education."

The Proposed Facility

Learners of all ages would explore extinction, speciation, evolution, animal development, etc., in ESB B-01A. This exhibit space adds $300ft^2/28m^2$ to the present Paleontology Museum. Hands-on activities using 3-D printed specimens and other materials, would be available to all visitors on table-tops located above the display/storage drawer cabinets in ESB B-01A. Designated drawers will showcase the range of trilobite diversity. The collection will be examinable in more detail (geography, magnified views, interesting facts, etc.) using a touch screen installed in the room. Visitors will use the touch screen to engage in activities based on exhibit content to enhance, or test, their knowledge. Activities customized to university course content would also be hosted on the touch screen. An introductory wall panel would describe the U of A's world-class trilobite collection, and two panels will showcase topics in evolution, extinction and adaptive radiation, topics taught in first and second year courses in the Departments of Earth & Atmospheric Sciences, and Biological Sciences. Future exhibits may be collaborative in nature between the Department of Earth & Atmospheric Sciences and the Department of Biological Sciences building upon the achievements of the trilobite-focused display.

Presently, the Paleontology Museum and the Department of Earth & Atmospheric Science's other public educational facilities (Mineralogy/Petrology Museum, and Geoscience Garden — a TLEF project — receive about 5000 visitors annually. Visits may be self-guided or lead by

trained undergraduate/graduate students. Over 1250 university students visit for coursework in five different undergraduate courses in Earth & Atmospheric Sciences. Around 1400, visitors are kindergarten through grade 12 students, are taking part in guided classroom visits to meet curriculum objectives, be exposed to the post-secondary environment and learn about potential career opportunities in earth sciences. Other visitors include out-of-school care groups, summer camps, university students from the U of A and other post-secondary institutions, and the public. The museum is the perfect venue for the Trilobite Learning Center.