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TWO HUNDRED YEARS OF DISCOVERY: USING GOOGLE EARTH TO RAISE AWARENESS OF SCIENTIFIC RESEARCH AT THE ACADEMY OF NATURAL SCIENCES OF DREXEL UNIVERSITY

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ABSTRACT

The Academy of Natural Sciences of Drexel University is a non-profit organization that is the oldest natural science research institution and museum in the Americas. This year, the institution celebrated a monumental 200th anniversary. As part of its year-long bicentennial celebration, an online supplement to the bicentennial exhibit was created. A Google Earth file that documents the Academy's widespread research will be available for the public on the Academy's website, http://ansp.org. To encourage exploration and engagement with the content of the Google Earth file, a series of educational activities were created, targeted for middle school science educators and students. The week-long curriculum is based off of the Google Earth file and is supported by ideas from the Earth Science Literacy Initiative, the ABCD model for writing learning objectives, the effective pedagogies Bloom's Taxonomy of Learning, and the Pennsylvania State Science Education Standards.

Keywords: Academy of Natural Sciences, Google Earth, science education, Bloom's Taxonomy, ABCD model, Earth Science Literacy Initiative

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Chapter 1

Introduction

Philadelphia's Academy of Natural Sciences of Drexel University recently celebrated a monumental anniversary. In March 2012, the institution commemorated two hundred years of research and scientific discovery. The Academy, known for its dinosaur exhibits and live animal shows, is not only a museum but an organization that has pioneered scientific research and expeditions since its inception in 1812. The Academy planned a year-long bicentennial celebration with special events and public engagement programs and an evolving bicentennial exhibit, "The Academy at 200: The Nature of Discovery," to display historic specimen collections, current scientific research, and a peek inside the future of the museum.

In order to raise awareness of the institution as a research center, the idea of developing a web-based tool for public outreach was discussed at the Academy. I became an intern at the museum in the spring of 2011 to work closely with the staff on a public outreach project that would ultimately be used for the Academy's bicentennial celebration. As a result, a virtual map including some of the Academy's research expeditions has been created to display on the Academy's website during the bicentennial year. The virtual map, in the form of a Google Earth file, is accompanied by a week-long series of lesson plans for middle school science teachers to use in their classrooms. The Google Earth file is a geographic representation of past and current research endeavors displayed on an interactive virtual globe. The activity series consists of five lesson plans with accompanying worksheets for the science classroom, each encompassing a forty-five to fifty minute class period. These student worksheets and accompanying teacher guides can be used as a week-long curriculum, as a group of stand-alone activities, or as a gateway for patrons to interact with the Academy and its global endeavors from the comfort of the home of the virtual visitor.

The Academy of Natural Sciences

The Academy of Natural Sciences of Drexel University is a non-profit organization that is the oldest natural science research institution and museum in the Americas. Founded in 1812 and originally called the Academy of Natural Sciences of Philadelphia, the institution was housed on Broad and Sansom Streets. In 1828, the Academy opened to the public. As the collections expanded rapidly with the contribution of gifts, purchases, exchanges, and expedition specimens, the Academy sought a larger location. In 1876, the organization moved to its current location at 19th Street and Benjamin Franklin Parkway, which has undergone major renovations to house its ever-expanding collections, programs, and staff. Although Benjamin Franklin Parkway was on the outskirts of Philadelphia in the late 19th century, it is now home to the cultural hub of the city. The Academy of Natural Sciences sits beside Logan Square, neighboring its cultural counterparts, the Franklin Institute, Moore College of Art and Design, and the Philadelphia Free Library.

The Academy of Natural Sciences is not just a dinosaur museum. The research institution and museum houses over 17 million catalogued natural history specimens and artifacts in its collections, and is among the ten largest collections in the United States (Academy of Natural Sciences, 2011). It is home to an education department that hosts field trips for both children and adults, educational programs for fairs and festivals, and a host of special initiatives for young students in the Philadelphia area (including Girl and Boy Scouts, homeschooled students, and young women interested in natural science). Explorers' Camp is popular with elementary school students every spring and summer, as are the educational birthday parties and safari overnights.

The Academy also has an active research department that has remained at the forefront of scientific discovery since 1812. The Academy is host to the Center for Systematic Biology and Evolution (CSBE), the Patrick Center for Environmental Research (PCER), the Ewell Sale Stewart Library and Archives, the Laboratory for Molecular Systematics and Ecology (LMSE), and the new initiative for environmental protection and sustainability in Mongolia, the Asia Center. The institution provides many research opportunities for researchers and students including hands-on work with Academy scientists, employment, fellowships, grants, awards, and internships.

In the fall of 2011, the Academy's President and CEO, George Gephart, Jr., and Drexel University President, John A. Fry, announced the completion of a new partnership between the Academy and Drexel University. On October 26, 2011, the milestone was celebrated with a day of free events at the newly-minted Academy of Natural Sciences of Drexel University. Both institutions have been pioneers in scientific research, and the partnership hopes to "promote discovery, learning, and civic engagement in the natural and environmental sciences" (Academy of Natural Sciences, 2011). A new department has also been added to Drexel's science programs. The Biodiversity, Earth and Environmental Sciences (BEES) Department will bring scientists from both organizations together and will begin taking students in the fall of 2012.

The Academy's Bicentennial

Just before the partnership between the Academy of Natural Sciences and Drexel University was solidified, the Academy began publicizing an upcoming historic event, the institution's bicentennial. In March 2012, the Academy of Natural Sciences of Drexel University celebrated its 200th anniversary. As an intern at the Academy of Natural Sciences during the summer of 2011, I witnessed the excited flurry of preparations for a year-long bicentennial exhibit, which would include a rotating display of various collections from the disciplines studied behind the Academy's museum doors. An enormous timeline would chronicle the highlights from the institution's 200 years of existence. An 80-foot-long wall would feature "an extraordinary sampling of the Academy's more than 17 million specimens from nature" (*The Academy at 200*, 2012, para. 5). Throughout the year, some of the accomplishments and ground-breaking research of staff scientists will be presented for the public, as well as displays of historic specimens from the hundreds of expeditions sponsored by the institution over the past 200 years. Various collections from CSBE, PCER, LMSE, the Asia Center, and the Ewell Sale Stewart Library and Archives will be available for public viewing during the year of 2012.

Purpose

Public outreach is an important element of a non-profit organization's agenda, and one of the Academy's goals for its bicentennial year is to increase public engagement. In this digital age, web-based supplements to museum exhibits and special events serve as an effective means of drawing the public into places like the Academy. The addition of bicentennial-themed content to the Academy's website adds not only to the existence of the Academy's online presence and social network (found on Twitter: http://twitter.com/AcadNatSci/ and Facebook: http://facebook.com/AcademyofNaturalSciences), but to the excitement the organization has generated around its monumental anniversary.

To help increase public engagement with the institution's historic collections, a promotional and educational tool for the museum's website has been created. This tool comes in the form of a Google Earth file that documents highlights of the Academy's 200 years of scientific research -- from the male-dominated hunting trips of the 1800s and the unprecedented work of female ecologist, Ruth Patrick, in the 1940s to today's ground-breaking research conducted in Mongolia, Brazil, the Bahamas, and Arctic Canada. The easy accessibility of the internet and free program, Google Earth, provides the public with an at-home experience of the revolutionary scientific work that has been conducted at the Academy since 1812. The Google Earth file and a series of supplemental educational activities will also provide middle school science teachers with a week of lesson plans that allow students to explore history, culture, and science through the technology of Google Earth. All of this content is available to the public for free download on the Academy's website (http://ansp.org), as well as here in this thesis.

Chapter 2

The Role of Google Earth in Science Education

Google Earth

Google Earth (http://earth.google.com) is a free, downloadable program that allows users to interact with a virtual model of our planet. The program, launched in 2005, ties satellite imagery to latitude and longitude to create an interactive virtual globe for its users. If a user types an address or a famous landmark into the "Search" function, the program is able to virtually transport users from the Eiffel Tower to Washington, D.C. to the Sahara Desert or to their own backyard. With its visual and geographic nature, Google Earth has been used frequently in classrooms to enhance the work of educators in many disciplines. Educators have been eager to bring technology into the classroom as a means of engaging students, especially in secondary-level science classes, where engagement is usually very low (Sullenger, 2006).

In addition to the "Search" function, one of the biggest draws for educators is the collection of content several global organizations have contributed to Google Earth. By pinpointing specific locations to highlight photographs, videos, and important history, organizations like the World Wildlife Foundation (WWF), Greenpeace, The United Nations' Children's Fund (UNICEF), National Geographic, and the National Oceanic and Atmospheric Administration (NOAA) have added their own "Layers" to the program. This existing information has made the program very appealing to educators, as it contributes to an interdisciplinary look at geography.

The advanced technology of Google Earth, with its geospatial and visual components, has created a powerful tool not only for classroom educators, but for informal educators as well. In a world dominated by social media, informal education institutions have been learning how to engage with patrons online through the use of Facebook, Twitter, and other interactive online platforms. Geospatial information – data that is linked to specific geographic locations – has an increasing technological presence. The geospatial technology of Google Earth can put a museum's collections into a geographic context, creating a more meaningful experience for those who interact with the collections.

Creating specialized content in Google Earth for the Academy of Natural Sciences became the starting point for this thesis. Much like the existing "Layers" of information created by WWF, UNICEF, National Geographic, and NOAA, the Google Earth file created for the Academy is a collection documenting research unique to the institution that has been made available for public consumption. One of the advantages of Google Earth is the program's ability to place relevant, everyday content into a geographic context, making it even more relatable for consumers.

The Anatomy of Google Earth

In order to create Google Earth's virtual globe, satellite imagery is stitched together in the Google program, creating a comprehensive, in-depth look of our current world. This globe is a starting point for users to explore our planet, using the options in the lefthand sidebar and the top toolbar (Figure 2-1). Users can use the "Fly To" tab in the search box to travel to any location on earth. The high-quality imagery allows users to zoom in and out, from city rooftops to outer space. The program contains pre-programmed layers of information from various government agencies, environmental organizations, and historic libraries. In addition to flying around the globe, users can use the pre-existing layers to find local businesses or restaurants, view historical imagery or 3D buildings, and even explore the oceans and our Moon.

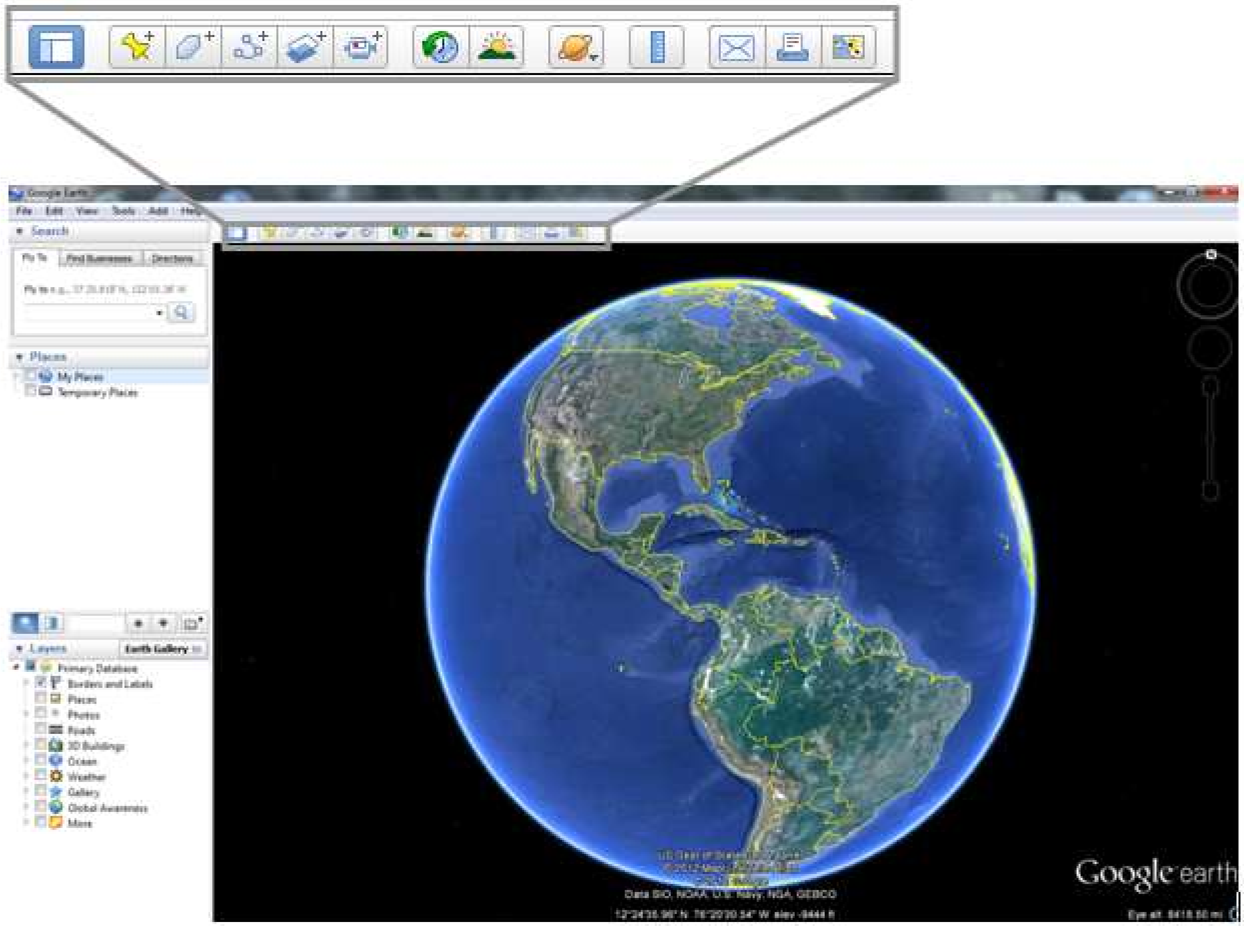

Figure 2-1: The basic Google Earth interface includes a globe comprised of satellite imagery, a search function, saved places, pre-existing layers, and other tools at the top that allow users to add their own content.

Users are able to add their own locations to the "Places" menu by using the "Add Placemark" tool indicated by the yellow pushpin in the top toolbar (Figure 2-1). This will place a yellow pushpin on the map, "pinning down" a desired location. Users are then able to add an information window for each placemark. Placemark information windows may include text, basic hypertext markup language (HTML), photos, hyperlinks, audio files and videos (Figure 2-2).

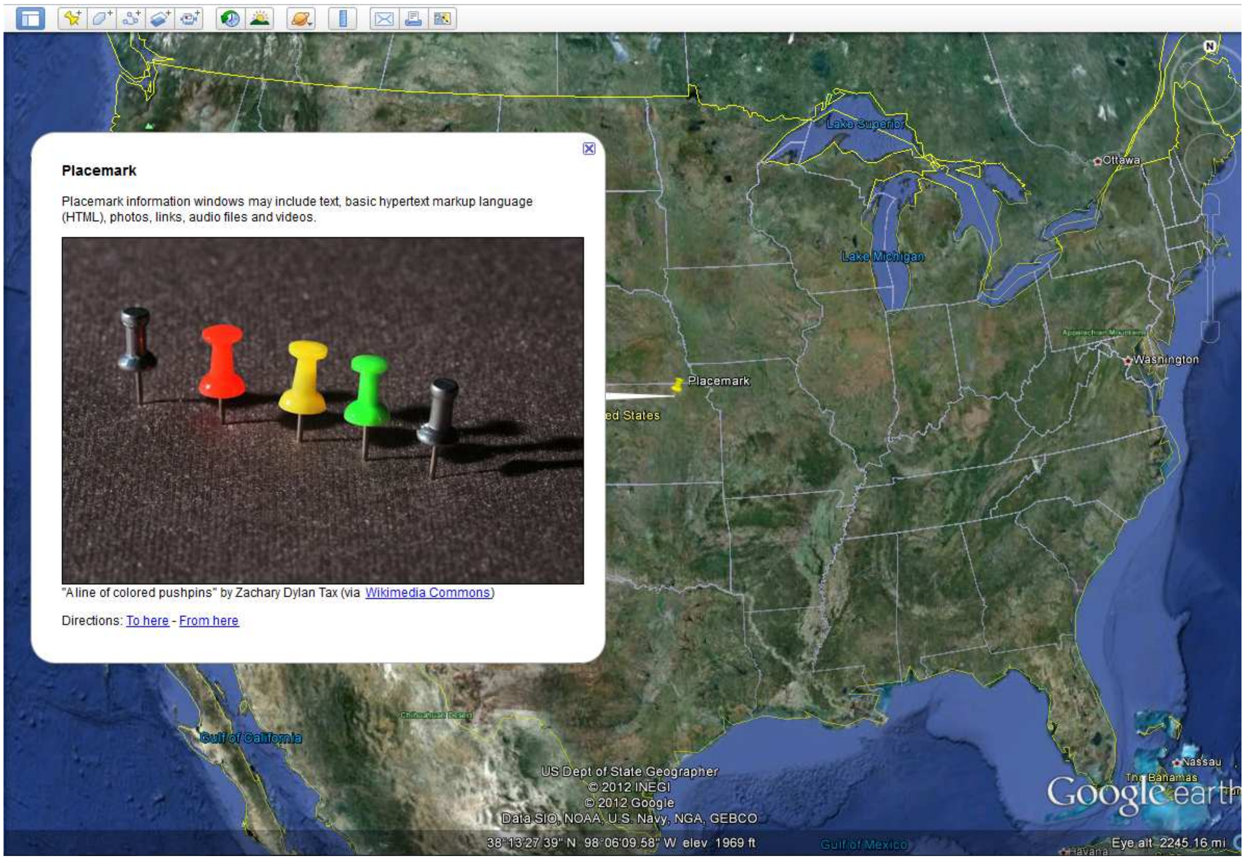

Figure 2-2: A placemark example, featuring an image and a hyperlink ("A line of colored pushpins" by Zachary Dylan Tax courtesy of Wikimedia Commons).

Placemarks can be used to relate geographic locations to historic events or to track literary characters throughout the course of popular books (Burg, 2006). Science teachers can create virtual tours of nonfiction, science-based books to relate current research to their curriculum (Neville & Guertin, 2009). Geospatial technology has also been used for virtual field trips, studies on urban elementary learners, teachers' perceptions of technology in the classroom, geography, national and international organizations, and volcano characteristics, to name a few (Grossner et al., 2008; Patterson, 2007; Clary & Wandersee, 2010; Schipper & Mattox, 2010).

The Google Earth files commonly used in classrooms are made up of several placemarks on the virtual globe. After a series of placemarks is created and placed in a folder in the Places menu, it can be saved as a .KMZ file, which is the same as a zipped KML file (Figure 2-3). KML stands for keyhole markup language, the coding used specifically for creating content in Google Earth.

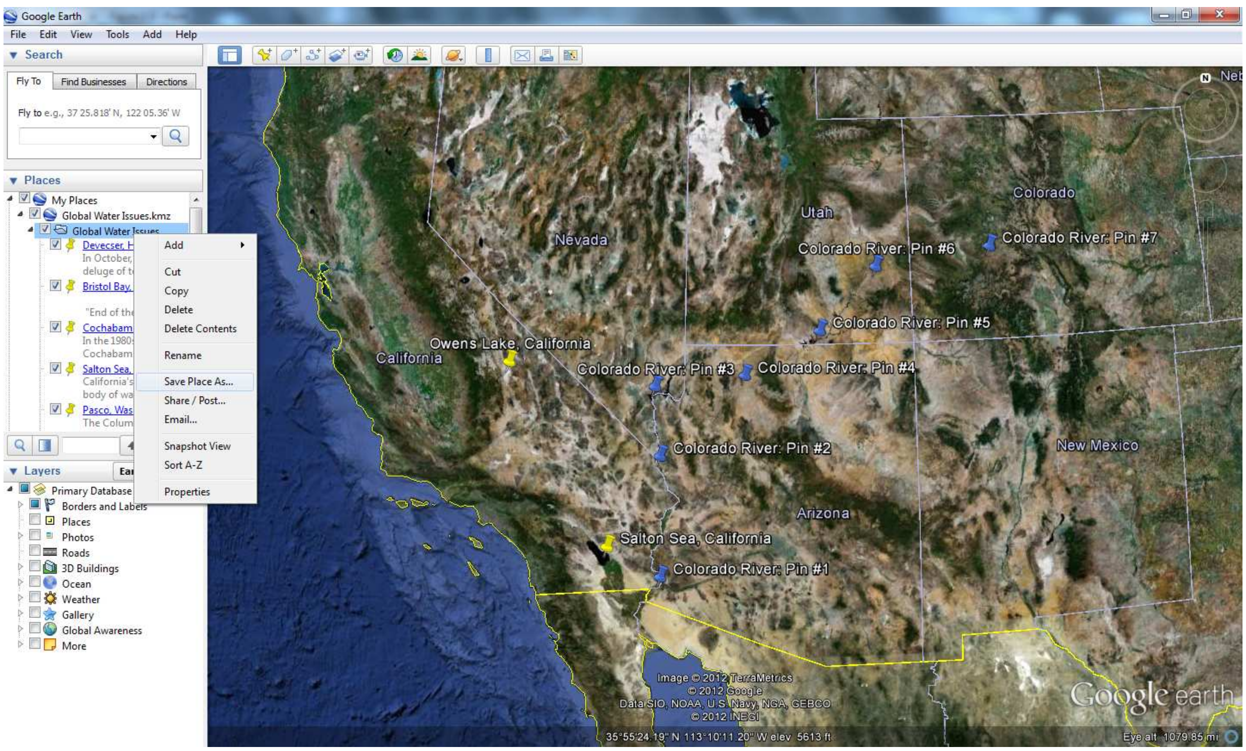

Figure 2-3: In the Places menu, a folder of placemarks titled “Global Water Issues” has been saved. A handful of the placemarks from this educational file are shown here in Google Earth. A series of placemarks can be saved by right-clicking the folder to which they belong and selecting “Save Place As…” from the dropdown menu. The folder of placemarks will then be saved as a .KMZ file.

Spreadsheet Mapper

The Google Earth Outreach team has developed a tool that makes it easier for users to create their own content. This tool, called Spreadsheet Mapper, allows users to create their own Google Earth files without having to learn complicated KML coding. Spreadsheet Mapper is set up using Google Docs, and operates much like a Microsoft Excel spreadsheet (Figure 2-4). Google Earth Outreach's Spreadsheet Mapper tutorial (http://earth.google.com/outreach/tutorial_spreadsheet.html) provides a step-by-step guide on how to use the template in Google Docs. Users are prompted to plug in specific information such as folder name, placemark name, latitude, longitude, and the desired text (with any accompanying HTML for photos, videos, and other multimedia).

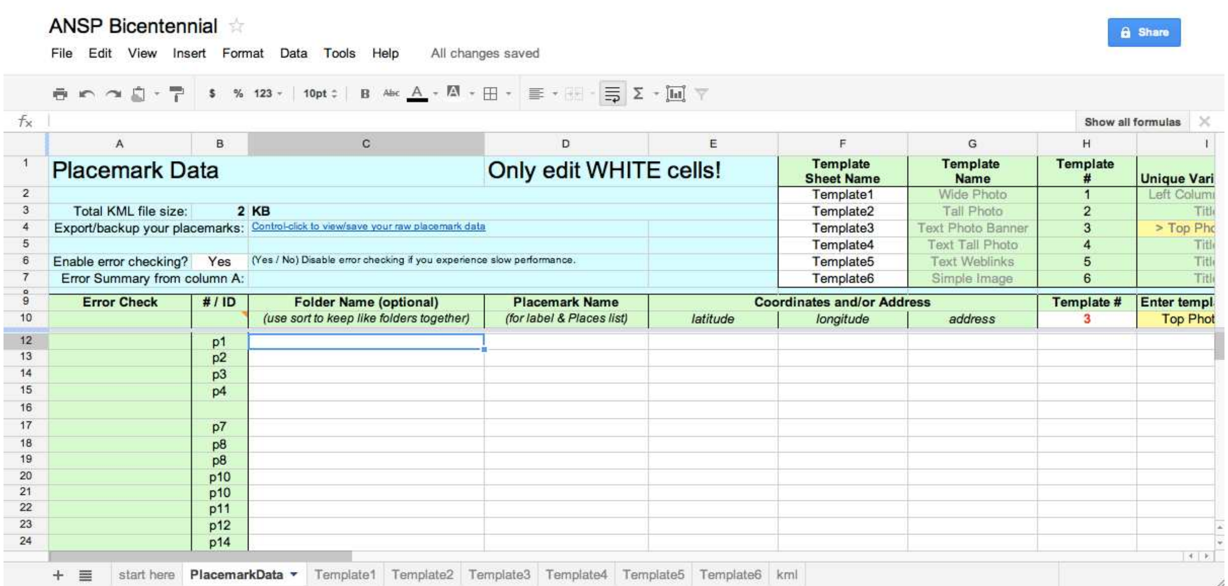

Figure 2-4: The blank Spreadsheet Mapper template, opened in Google Docs

The Spreadsheet Mapper template in Google Docs provides directions for users to publish their content on the internet. This feature generates a code for users, which can be added to the “Places” menu in Google Earth, and will ultimately allow the content to be saved as a .KMZ file.

Spreadsheet Mapper was used for this project for several reasons. Although users can create placemarks in Google Earth without using Spreadsheet Mapper, there is a limit on the number of pins one can create in a single file. Spreadsheet Mapper allows the user to create large files, such as the one for this project. Ideally, the project will not be over with the completion of this thesis. As research continues at the Academy of Natural Sciences, the plan is that the Academy will continue to add to this Google Earth file, creating a comprehensive look at the research done at their institution. This is another reason Spreadsheet Mapper is useful. The template is in Google Docs, which means that it is shareable. Access can be given to employees at the Academy, and this file will not have to remain static. It can be a continually-growing project for the institution that will continue to engage its online visitors.

Google Earth in the Classroom

Science educators today often struggle with student engagement. Strict educational standards and scheduled testing have created a stressful atmosphere for many science teachers, preventing them from allowing time for genuine, exploratory learning. Teachers are often pushing students to do well on tests, that content material is lost or forgotten in the process. As a means of making sure teachers effectively communicate the most important scientific concepts to their students, the National Science Foundation funded the Earth Science Literacy Initiative (ESLI). This initiative pinpoints the overarching themes that support all facets of Earth science. The ESLI has helped educators focus their standards-based lessons in an effort to construct a strong foundation of knowledge for their students. This has helped science teachers feel more competent, as they have specific, unchanging objectives for their students to learn.

The exponential growth of technology in the past few years has also helped classroom teachers with student engagement. Technology is a language that today's students speak fluently. The use of the internet, social media, and a variety of educational software has been a way for students to challenge themselves. In learning these new technologies during classroom activities, students find themselves immersed in educational content. Programs like Google Earth have been an effective means of engaging students.

Educational Standards vs. Authentic Discovery

Informal science education is focused on principles that are valuable to science educators in all types of classrooms, from kindergarten to graduate school, from public school classes to the most unstructured of learning environments. These guiding principles aim to provide students with a deeper understanding of relevant scientific content, while increasing student engagement in science, and encouraging creativity ("An NSTA," 1998). In the classroom, the National Science Teachers Association (NSTA) and educational standards encourage hands-on, experiential learning in order to increase student participation, and to make science more inviting and less intimidating (Delacote, 1998; Macdonald et al., 2008).

As helpful as the standards are for educators across the country to unify their subject matter, providing all American students with a very similar K-12 experience, strict standardized testing schedules often leave little time for hands-on learning (NSTA, 1988). Standardized testing pushes educators to "teach to the test" (the notion that teachers only teach the concepts that students will be tested on, leaving out other important lessons) which often sacrifices a student's true understanding of difficult science material. Hands-on learning is swapped for rote memorization and the ability to reproduce lecture notes. Most experimenting with science only occurs at informal institutions or within community-based groups, making informal science educators an important source of real learning for young students (Delacote, 1998; Abraham-Silver, 2006).

In order to create better focus in science education, the National Science Foundation (NSF) teamed up with research scientists and educators to generate a list of the most important concepts science students must know. The Earth Science Literacy Initiative is a list of Earth science's nine "Big Ideas" (explained in greater detail in Chapter 3), or the overarching lessons that are recommended for instruction in the classroom. Each Big Idea has a set of sub-concepts that are "comparable to those underlying the National Science Education Standards and the American Association for the Advancement of Science Benchmarks for Science Literacy" (Earth Science Literacy Initiative, 2010b, p. 2). The goal of these Big Ideas is to create a higher level of Earth science literacy, not only for students to better understand the world, but to help "shape decisions by government and industry [and] improve our understanding of Earth" (Earth Science Literacy Initiative, 2010b, p. 3).

Educators are encouraged to use the Earth Science Literacy Initiative's Big Ideas to support their curriculum and enhance the learning guided by state education standards. As helpful as these big ideas are to create focus in the classroom, for some, all of these guidelines can seem overwhelming. Guidelines, standards, and testing can leave science educators desperate for the desired experimentation and exploration that greatly benefits their students.

Even when there is enough time for experimentation and exploration, it is often difficult to engage every student, making science an increasingly demanding subject to teach. Due to classroom difficulties (including, but not limited to learning styles, gender differences, restrictions for those with disabilities, and cultural and financial limitations), student interest in science and mathematics dissipates in elementary school, and educators' confidence in teaching dwindles (Sullenger, 2006; Goetz, 2007; Macdonald et al., 2008; Duran et al., 2009). This presents science educators with the problems of engagement and increasing students' interest; an educator's confidence in teaching relies on these things. How do teachers engage their students?

Educators need to find ways to draw their students in. Making science relevant and relatable is the key. As authentic discovery is the most powerful experience a student can have with science (Abraham-Silver, 2006), educators must find a way to let the students drive their experience. Exposing students to hands-on experimentation and exploration will not only engage students, but allow them to find personal connections to the subject matter. This, in turn, increases student interest. When students take control of their learning, they are more successful (Abraham-Silver, 2006). With the revolutionary online and technology tools we have today, educators have an easy way to communicate with students through technology. Technology literacy is one step toward engaging today's youth in a more meaningful way. Technology is a language that teenagers speak, and teachers are beginning to harness its power.

Informal Science Education

Although authentic discovery is hard to cultivate within the confines of a classroom, science teachers can spark discovery by studying the work of informal science institutions

(Abraham-Silver, 2006). Informal science education thrives in museums, nature centers, and community science groups. These relaxed environments allow for the hands-on experimentation and authentic discovery classroom teachers so desire.

Part of the success of informal science education is the choice-driven atmosphere and the very nature of exploration itself. As children explore independently, their choices often lead to interdisciplinary learning. Young students who investigate what appeals to them, will, in turn, learn about other disciplines. For example, a student interested in dinosaurs may dig for fossils in a museum, thus learning about paleontology, and perhaps the geologic time scale, history, and geography as well. Interdisciplinary work has proved to be beneficial for many programs and initiatives aimed at improving science education (Kelley, 2010). In order to encourage both educators and their students to connect with science and understand it, professional development programs and workshops are often created, and partnerships between universities and museums are cultivated (Macdonald et al., 2008; Duran et al., 2009). Educators often need extra support to make science appealing as student engagement and interest decreases. Informal learning institutions are able to provide that support.

According to the National Science Foundation, informal learning is all about public outreach and the "understanding and excitement about science from self-directed, voluntary explorations" (Duran et al., 2009, p. 53). Public outreach is one of the most important missions for informal science education institutions and organizations (NSTA, 1988; "An NSTA," 1998; Kelly et al., 2002; Russell, 2005; Sullenger, 2006). Various museums have documented collaborations with local universities, schools, and community-based organizations to increase public awareness of topical cultural and scientific themes (Kelly et al., 2002; Russell, 2005). Public programs, though not always tied to particular schools, help increase scientific literacy and make learning science more appealing with games, crafts, social activities, and special exhibits.

With the evolution of the internet, museums are always searching for new ways to digitally engage the public. Museum professionals have identified the importance of reaching their visitors and potential learners through websites and other social media outlets (MacArthur, 2007; Russo, et al., 2007; Arends et al., 2009). The relationships between museum professionals, visitors, and the institutions themselves have changed drastically due to communication-changing technologies (Marty, 2006; Marty, 2007; Russo et al., 2007; Russo et al., 2009).

Museum professionals who have studied and utilized online communities to bolster their relationships with visitors have stressed the importance of both exploratory features (including browsing/searching for content, social tagging, rating content, uploading and sharing personal relevant content), and educational features (interactive games and maps, discussion boards, cyber-exhibits) of various internet sites (MacArthur, 2007; MacFadden, 2008; Arends et al., 2009).

Chapter 3

Methods

The Google Earth file documenting the Academy's research is an effort to increase public awareness of past and present scientific expeditions. The Google Earth file provides online visitors with a sense of breadth, in terms of the institution's ongoing scientific research. Placemarks indicate select locations where scientists have traveled in the past 200 years, and information windows provide users with a summary of the scientists' research goals and findings, personal photos and anecdotes, and an intimate look at what scientific research is all about. The Google Earth file can either be displayed directly on the Academy's website through a plug-in (Figure 3-1), or it can be uploaded to their server and given to online participants as a link that leads to the free download of the file.

Figure 3-1: An example of the Google Earth plug-in, available at http://earth.google.com/plugin

In addition to the Google Earth file, a week-long set of curriculum instruction has been developed for secondary science teachers. The activities are geared towards 6th through 8th grade students, using the Pennsylvania State Academic Standards for Science and Technology and the Earth Science Literacy Initiative as guides. The activities also incorporate two popular and effective teaching pedagogies: the ABCD model for writing learning objectives and Bloom's Taxonomy of learning domains (both described in detail later in this chapter).

Researching the Academy's History

Research for this thesis began in February 2011, with a meeting with the Manager of School Programs at the Academy. The meeting was set up to figure out how to best use my previous knowledge of the educational uses of Google Earth for the Academy's benefit. The Manager of School Programs became my contact person at the Academy and introduced the idea of contributing to the bicentennial celebration in March 2012. The suggestion was to create a Google Earth file that documents Academy science and research around the world.

The Google Earth file began as a rough outline of scientific expeditions. Since its inception in 1812, the Academy of Natural Science has sponsored hundreds of research endeavors. From 1812 to 1962 alone, the Academy led 371 expeditions (Peck, 2010, p. 46), and as global travel has become easier, the number of expeditions has increased exponentially. For the purpose of the Academy's anniversary, a list of the institution's most significant expeditions was compiled. The goal was to hunt down any literature on these expeditions in the Academy's online finding aids and guides (http://ansp.org/archives/), and with the help of Academy employees. The acting librarian of the Academy's Ewell Sale Stewart Library and Archives agreed to provide a list of her top ten favorite expeditions. Her first suggestions were the second expedition of Brooke Dolan to Western China and Eastern Tibet in 1934 and Angelo Heilprin's 1890 expedition to the island of Martinique. The other historic expeditions included in the Google Earth file are Titian Ramsay Peale's exploration of the prometheus moth in the Philadelphia area, the infamous rivalry between Edward Drinker Cope and Othniel Charles Marsh, the work of Haddonfield New Jersey's naturalist, Samuel Rhoads, Clyde Goulden's work in Mongolia from 1994 to 1997, the discovery of the "new" ancient specimens, *Tiktaalik rosae* and *Laccognathus embryi* in Nunavut territory, and recent projects of current employees of the

Academy, Mark Sabaj Perez, Dr. Katriina Ilves, Dr. Nate Rice, Jerry Mead, and Michelle Brannin.

200 Stories

For the Academy's bicentennial celebration, several public outreach initiatives were established to generate excitement for the March 2012 anniversary. A year-long celebration of the Academy's 200 years of scientific discovery began at the end of March 2012. One of the public engagement initiatives involved telling stories unique to the Academy's history and research. Two hundred of these accounts, each with their own story to tell, were compiled and posted on the Academy's website, at http://ansp.org/200/stories. Starting in September 2011, a story a day was posted for the two hundred days leading up to the March 24th bicentennial kick-off. The stories ranged in topic from how to become an Academy volunteer to the involvement of Charles Darwin, Ernest Hemingway, and Edgar Allen Poe at the Academy.

In August 2011, after researching a few historic expeditions, I began to explore Spreadsheet Mapper to facilitate the process of creating the Google Earth file. After exploring the tutorial and drawing upon my existing knowledge of HTML coding, a streamlined layout was created for the information windows in the Google Earth file. Each Academy expedition would be documented in three to five placemarks. At this point in the research process, with very little content to work into Spreadsheet Mapper, I decided to use some of the existing bicentennial stories from the Academy's website to generate a mock-up of the Google Earth file.

After exploring Spreadsheet Mapper and creating a small mock-up of the Google Earth file, I decided to add a folder of stories from the bicentennial initiative to the file. I used some of these stories not only to supplement my work, but to connect it to something tangible on the Academy's website, taking the existing content one step further for the website's viewers.

The stories collected from the Academy's website helped to better visualize what the Google Earth file would look like. As information about other historical expeditions was still being collected, I found stories from http://ansp.org/200/stories to add to the Google Earth file. With verbal permission from my contact at the Academy, I began to collect stories with strong geographical ties, famous figures, or intriguing anecdotes from the website and added them to the Google Earth file in a folder separate from the other expeditions. The project began to evolve into a two-part Google Earth file: one folder of the Academy's stories leading up to the bicentennial, and a series of folders that went into more detail about the most important scientific expeditions from the Academy's past and present.

Spreadsheet Mapper was used to create the Google Earth file. After pulling details from each story or expedition, photos and links were added to the Google Earth file by typing HTML coding into the template provided by Spreadsheet Mapper. The full code can be found in Appendix A.

Current Research

After collecting the famous accounts of international field research and using some of the bicentennial stories, I was introduced to several scientists currently involved in research at the Academy including entomologists Jason Weintraub, Greg Cowper, and Jon Gelhaus, ornithologist Nate Rice, ichthyologists Katriina Ilves and Mark Sabaj Perez, and botanist John

Hall. With the help of these Academy employees, the list of historic expeditions was supplemented by anecdotes about current research.

In June 2011, I accompanied staff scientists Jerry Mead and Michelle Brannin to a local stream for one of the education department's adult field studies. The Academy hosts many educational programs for adults, one of which is an ongoing series of field studies led by Academy scientists. I tagged along with Jerry and Michelle and a handful of other volunteers to work with the PCER scientists on a study of Crabby Creek in Paoli, Pennsylvania. I documented the experience and added it to the Google Earth file.

The Samuel Rhoads Collaboration

One of the scientists at the Academy, Dr. Nate Rice, introduced me to one of his volunteers in the ornithology department, Kim Custer. Kim had been working as an archivist at the Haddonfield Historical Society in Haddonfield, New Jersey, on a project uncovering the life's work of naturalist Samuel Rhoads. Kim was also working with students from Haddonfield Memorial High School who volunteered at the historical society, all of who had an interest to learn more about this relatively unknown hometown hero.

Kim and her team at Haddonfield Historical Society provided a thorough look at Samuel Rhoads' research. His collections of specimens are housed at the Academy of Natural Sciences, while most of his personal belongings (journals, photographs, published papers, etc.) reside in Haddonfield. The opportunity to work with Kim and her students helped me to see the importance of archives, and the great amount of work Samuel Rhoads accomplished in his life.

Creating the Google Earth File

As the stories previously mentioned were collected, I began synthesizing my research so it was succinct enough for the Google Earth file. The goal was to create a series of folders, each with three to five placemarks inside. Each folder would come to represent one scientific research expedition, with the placemarks highlighting different locations in the field. Each placemark includes a header image (specific to its particular expedition), a few paragraphs summarizing the importance of the pinpointed location, and an accompanying image. Locations were pinpointed by converting GPS coordinates to latitude and longitude. All of this information was plugged into Spreadsheet Mapper.

Research began with Brooke Dolan's expedition to Western China and Eastern Tibet. I read his article from a 1936 volume of the *Proceedings of the Academy of Natural Sciences* (a journal that is still published at the Academy today), and created placemarks in Shanghai, Chengtu, Tachienlu, Batang, and Jyekundo. To collect images and more information about Dolan, I was able to look through the archives at the Ewell Sale Stewart Library at the Academy, and I attended the annual sportsman's dinner in the fall of 2011.

As I began to gather images, I decided that all of my photos for this project would be hosted on my academic blog through http://tumblr.com. I either uploaded my own photographs to the site, or I re-uploaded copyright-free images with the appropriate attribution to ensure that the photos for this project would remain active.

Research for the other historic expeditions consisted of finding reading material through the Ewell Sale Stewart Library and Archives or synthesizing content given to me by Academy scientists. The process was similar for each expedition documented: read and summarize the content, gather images of my own or copyright-free images, upload images to Tumblr, plug content into Spreadsheet Mapper. The Google Earth file was finished in January 2012.

Chapter 4

Pedagogical Approach

This endeavor is a project in two parts: the Google Earth file for the Academy of Natural Sciences, and the educational component that is available for middle school Earth science teachers, other interested educators, and the general public interested in the history of the Academy's expeditions. The week-long series of activities for the middle school science classroom have been aligned with the National Science Foundation-funded Earth Science Literacy Initiative, which are literacy standards created to support national science education standards. Learning objectives were created for these activities using the ABCD model, and assessment questions for students were enhanced with the pedagogical approach, Bloom's Taxonomy. Utilizing these educational frameworks created an effective way of incorporating the Academy's Google Earth file in the classroom.

The Earth Science Literacy Initiative

In an effort to create a science-literate people in the chaos of our information-saturated internet culture, the National Science Foundation funded an effort to increase science literacy in schools. The Earth Science Literacy Initiative is a program that has highlighted the nine single-most important ideas of Earth science. Each of these "Big Ideas" comes with several supporting concepts, and this set of learning goals has been nicknamed BIaSCs ("Big Ideas" and Supporting

Concepts). The BIaSCs is a list of the overarching concepts that must be taught in schools in order to to create a scientifically-diligent generation of citizens (Figure 4-1).

The Earth Science Literacy Initiative's Big Ideas
1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
2. Earth is 4.6 billion years old.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continously changing.
5. Earth is the water planet.
6. Life evolves on a dynamic Earth and continuously modifies Earth.
7. Humans depend on Earth for resources.
8. Natural hazards pose risks to humans.
9. Humans significantly alter the Earth.

Figure 4-1: The Earth Science Literacy Initiative's Big Ideas for science education.

State standards and testing benchmarks provide educators with guidelines for lesson content, but the standards generated for K-12 education are rarely updated and written in language that is hard to understand (Earth Science Literacy Initiative, 2010a, para. 4). The Earth Science Literacy Initiative created its list of BIaSCs to provide a clearer sense of not only what students need to understand about science, but what the average citizen should understand as well. These concepts must make their way beyond classroom walls. Many of the misconceptions people have about science are learned from pop culture, friends, family, or informal educational settings. To alleviate the development of misconceptions, the BIaSCs must be easy to understand, giving it crossover potential. Teachers must be consulting this list, but so should educational television programmers, textbook authors, and educational game developers.

Though the BIaSCs are a tool created mostly for school curricula and the creation of science textbooks, these concepts must travel beyond the educational sphere. Public understanding of the BIaSCs is paramount in order to contribute to making "future decisions involving governmental legislation" (Earth Science Literacy Initiative, 2010a, para. 1). The Earth Science Literacy Initiative (2010a) illustrates this importance:

> Someone trying to find out about an Earth science topic (a lawyer, engineer, museum director, textbook writer, legislator, etc.) could easily be overwhelmed by the amount of information available. A prioritization of essential ideas, carried out by the scientific communities, would provide the basis and framework that would help people navigate through the rapidly expanding amount of scientific information (para. 2).

The BIaSCs encompass everything from the definition of a hypothesis to the Earth's age, from the importance of the water cycle to how humans have an impact on the health of our planet. Responsible global citizens must be well-versed in these "Big Ideas," especially during this time of population increase and the strain on our natural resources. "Land use must be planned with maximum understanding of Earth science, and the BIaSCs created here will become part of a process that help guide the education and policy-making needed to allow it to happen" (Earth Science Literacy Initiative, 2010a, para. 8). This is why the BIaSCs are included in the teachers' guides for the activity series.

The ABCD Model

Creating measurable learning objectives for students can often be a challenge. The ABCD model, which has gained exposure in the academic realm, is a method that provides educators with explicit guidelines for creating succinct, usable learning objectives for students (Heinrich, et al., 1996). The ABCD model is made up of four components: Audience (A), Behavior (B), Condition (C), and Degree (D). Teachers are encouraged to use these four components (not necessarily in that order) as guides to create focused, easy-to-measure learning objectives. Creating clear course objectives is important not only to provide guidelines for the students, but because “objectives provide a link between expectations, teaching and grading” (Bixler, 2007, para. 2).

A crucial piece of creating learning objectives is addressing the appropriate audience. When thinking about the audience, an educator must think, “Who are my learners?” in order to properly tailor lessons to the correct audience. During this step of the writing process, educators must take a detailed look at their students: are they the same age? What learning differences do they have? Do they have the same background in the subject matter at hand?

The intuitive next step for teachers is to think about the behavior, or what they expect their students to do. The behavior should be described as an observable behavior, even if it is mental in nature, to make it easier for educators to gauge and evaluate. Behaviors often differ in cognitive ability, ranging from psychomotor skills to problem solving and affective development. This is often described as the “cognitive ladder” which students climb. Moving from the cognitive to affective domain is difficult for instructors as they try to write objectives. It is important to choose the powerful verbs to express a clear and measurable objective. Explicit verbiage is crucial for effective assessment. Effective assessments are needed not only to reflect student progress, but to measure “how effectively the teacher is teaching them, whether a certain topic or skill must be re-taught, and how involved students are in the class” (Johnson, Lang, & Zophy, 2011, p. 101).

After educators define the audience and behavior for their objectives, the ABCD model suggests moving to condition and degree. The condition refers to the circumstances under which students are to perform the defined behavior. What will be provided for the student in order for them to accomplish the desired task? The degree refers to what will be accomplished, how much a student is required to do and to what level. These guidelines round out the ABCD model, which makes writing learning objectives and assessing said objectives easier for instructors.

Bloom's Taxonomy of Learning Domains

Another pedagogical approach that is important to utilize when creating educational activities is Bloom's Taxonomy of Learning Domains. Much like the "cognitive ladder" referenced by the ABCD model, Bloom's Taxonomy is a psychological analysis of learning in three domains: cognitive, affective, and psychomotor. For this thesis, the diagram for cognitive learning was used. The diagram, often seen as a pyramid (Figure 4-2), begins with the simplest form of cognitive learning: remembering, or being able to recall previous knowledge. From there, students build upon material they have memorized and are able to climb up the "cognitive ladder" to achieve the other skills in the Bloom's Taxonomy diagram: comprehension, application, analysis, synthesis and evaluation.

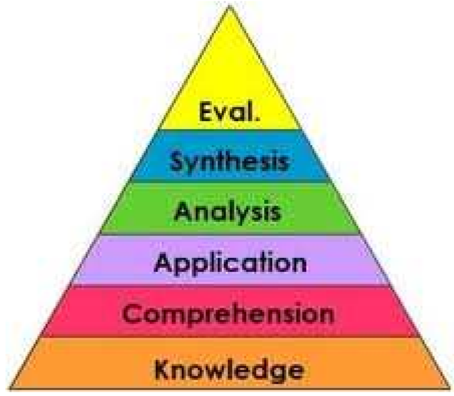

Figure 4-2: A figure illustrating the various levels of Bloom's cognitive domain ("Bloom Taxonomy"http://commons.wikimedia.org/wiki/File:BloomsCognitiveDomain.svg at Wikimedia Commons)

Bloom's Taxonomy has been identified as an educational cornerstone (Johnson, Lang, & Zophy, 2011). Educators build upon students' knowledge by challenging them to apply what they have learned and make real-life connections to educational material. Most effective is when educators create scaffolding activities – that is to say, when lessons or educational activities directly build upon a student's previous knowledge of the subject. This allows students time to get used to higher levels of thinking before moving up the "cognitive ladder."

According to Johnson, Lang, & Zophy (2011), teachers who understand the basics of effective objective and assessment creation are more likely to create meaningful activities using educational technology. By using Bloom's Taxonomy, educators are able to challenge their students to think critically, ultimately making their learning experiences more meaningful.

The assessment questions on the worksheets available for teachers for these Google Earth-related activities (Appendices B-F) encompass all levels of higher-level thinking in the cognitive domain of Bloom's Taxonomy. For example, the activity on Day 1 is centered on the purpose of an institution like the Academy of Natural Sciences. Students will take time to explore the Google Earth file in class, taking basic notes on the "who, what, when, where, why, and how” of several expeditions. These notes are at the bottom of Bloom’s Taxonomic scale (see Figure 4-2). By the end of the activity, once students have synthesized the information they read and took notes on, they are asked to write a reflective paragraph on the importance of scientific research. This will challenge students to step up the cognitive ladder by using comprehension, application, analysis, and synthesis in their writing.

The goal of these activities is not only to educate students about the Academy of Natural Sciences through the use of a powerful cognitive tool, but to challenge them to think critically and generate personal meaning from the material.

Chapter 5

Results

Educational Activities

Each activity in the week-long lesson plan for teachers is an exploratory supplement to the Google Earth file. The activities can be used in sequence, one activity per day, one after another for five days, or they can be used in any other order, per the instructor's discretion. However, the activities were created with a sequence in mind, each activity building upon a different facet of the Google Earth file, so that students will gain a comprehensive understanding of what scientific research at an institution like the Academy of Natural Science entails. For the purposes of this thesis, the activities are labeled "Day 1," "Day 2," etc., but again, these activities can be used in any way an instructor sees fit for their classroom.

The activity for Day 1 focuses on natural history museums. What is natural history? What are the natural sciences? What is a natural history museum? What bigger purpose do these institutions serve in our world today? With guidance and brief background information from the instructor, students will discuss and explore selected stories from the history of the Academy of Natural Sciences. Students will be exposed to scientific research and the various branches of study within the natural sciences. This is important not only to increase scientific literacy in our society (the importance of which is detailed in the section above, titled "The Earth Science Literacy Initiative"), but to raise awareness of potential fields of study for students who might be interested.

The activity for Day 2 focuses more specifically on individualized areas of scientific research. The Academy of Natural Sciences has twelve departments of research that are often overshadowed by paleontology and the front-room dinosaur exhibit. The instructor leads a classroom discussion based on different areas of scientific study conducted at the Academy's Center for Systematic Biology and Evolution and the Patrick Center for Environmental Research. The full list of disciplines is included in Appendix C. Students will explore the Google Earth file and fill in a T chart (Figure 5-1), matching various expeditions from the Academy's history with their corresponding scientific discipline. Students will then explore websites devoted to national and international scientific organizations and answer a series of questions that asks them to think about the interdisciplinary nature of scientific study. How do scientists work together? How does it make sense that two disciplines can be studying the same specimen? What type of skills do these scientists need, and where can they work? This activity will allow students to explore future career paths, while gaining a broader sense of what goes on "behind the scenes" at a natural history museum like the Academy of Natural Sciences.

Expedition	Discipline

Figure 5-1: An example of the T-chart students will complete for Day 1's activity.

The Day 3 activity takes the students back in time to Brooke Dolan's monumental expeditions to Western China and Eastern Tibet in the 1930s. Students will discuss the components of planning a research expedition before completing a worksheet that challenges their skills to read the virtual map provided by Google Earth. This will prepare students for the final project on Day 5. For the activity on Day 3, students will also be asked to apply some mathematical skills to answer questions about measuring distances traveled and area covered during the expedition.

The activity for Day 4 is a study of the research of two ichthyologists at the Academy of Natural Science. Students will read over the expedition summaries for Dr. Katriina Ilves and Dr. Mark Sabaj Perez. Ilves' and Sabaj Perez's work highlight the importance of conducting historical comparison research as well as generating a comprehensive catalogue of specimens for future scientific study. The instructor-led discussion and student worksheet will challenge students to think critically about the meaning behind historical research. Why is it important? How can comparative research and a comprehensive species catalogue be used in the future? This activity will place the ichthyology research into context, making students realize the importance of continual scientific study.

The final activity, Day 5, challenges students to thoroughly plan out their own scientific expedition. Students will be put into teams of three or four and will act as scientists and travel agents, planning a scientific research trip. Students must first agree on a discipline to study, a topic within the discipline to focus on, and a logical location where they can research their topic. After writing a short essay on the intent of their expedition, students will then work together to create a travel guide or brochure that documents all of the details of their upcoming trip. Details will include (but are not limited to) the cost of airfare, different languages spoken, necessary currency exchange, climate accomodations, and ideas about who and what they will need to bring with them on the trip. This activity is the culmination of all the previous curriculum, which will show students that being a scientist is much more than conducting experiments in a laboratory.

Conclusion

The goal of this thesis is not only to supplement the Academy of Natural Sciences' bicentennial celebration, but to educate the public about the Academy's research endeavors. Many people have the misconception that scientific research is conducted by men who wear glasses and white lab coats and spend all of their time in a laboratory. This project is a thorough examination of all types of scientific research conducted by museum scientists that will help battle those misconceptions.

The Academy of Natural Sciences is a historic organization that has brought the wonders of science to the public for two hundred years. The Google Earth file and supplemental educational material included in this thesis is an attempt to perpetuate public outreach, allowing the wonder of science to be seen by patrons of all kinds.

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Appendix A

KML Output for Spreadsheet Mapper


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research at the Academy, here are a few tips to maximize your Google Earth
experience:<ol><li>Use the menu on the lefthand side of your screen, titled "Places," to click
through the Academy's various research expeditions. You can click through them in order (which
is chronological), or in any fashion you choose!</li><BR><li>Beneath the "Places" menu, there
is a menu titled "Layers." There are different layers listed here that you can activate and
deactivate throughout your journey. Take some time to explore the layers to decide what you
would like to see as you travel across the globe and through time.</li><BR><li>Activate the
"3D Buildings" layer in the aforementioned "Layers" menu. To do so, just click the check box
next to the label "3D Buildings."</li><BR><li>After activating the "3D Buildings" layer, you
should now see a 3D set of buildings pop up around this information window in
Philadelphia!</li><BR><li>To learn about the Academy's global reach, click through the folders
and placemarks in your lefthand menu, "Places." Double click on a link in the "Places" menu (for
example: 1812 Academy Beginnings), and you will be zoomed across the globe to a location of
importance.</li><BR><li>Click through sequentially (from top to bottom), or explore however
you choose!</li></ol>Have fun, explorers!</p></p>       <p></p>       <p></p>
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Use the menu on the lefthand side of your screen, titled "Places," to click through the Academy's various research expeditions. You can click through them in order (which is chronological), or in any fashion you choose!
Beneath the "Places" menu, there is a menu titled "Layers." There are different layers listed here that you can activate and deactivate throughout your journey. Take some time to explore the layers to decide what you would like to see as you travel across the globe and through time.
Activate the "3D Buildings" layer in the aforementioned "Layers" menu. To do so, just click the check box next to the label "3D Buildings."
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To learn about the Academy's global reach, click through the folders and placemarks in your lefthand menu, "Places." Double click on a link in the "Places" menu (for example: 1812 Academy Beginnings), and you will be zoomed across the globe to a location of importance.
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illustrates a different piece of the institution’s history, and many of them are included in this Google Earth file.</p> <p>This folder, titled "200 Years of Discovery" is a smattering of these unique stories from the Academy's history. Click here to see the full collection on ansp.org.</p> <p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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Sciences:</p>        <p><p>On January 25, 1812, six gentlemen gathered on the second floor of
an apothecary shop on the northeast corner of Market and Second Streets in Philadelphia. The
group, which included two doctors, a dentist, an apothecary, a manufacturing chemist, and a
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distiller, was committed to creating a society for the cultivation of the natural sciences.

On March 21, the group discussed and agreed upon a constitutional act which established the Academy of Natural Sciences. The men decided that their friend Thomas Say, a gifted naturalist, should be recognized as one of the society's founders. Say’s work was critical to the success and growth of the Academy during its first years. Today the Academy leads the world in biodiversity and environmental research from its permanent home on historic Logan Square.</p></p> <p><p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.

<i>The apothecary shop at Market and Second Street where the founders held their first meeting (Image courtesy of ANSP)</i></p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<p><img src="http://26.media.tumblr.com/tumblr_ltfog3W7yR1qbxf1zo1_250.jpg" border=1 align=left> During the 18th and early 19th centuries, Adam Seybert was the only American with extensive knowledge of mineralogy. He had developed an increasing interest in the subject while studying under the famous crystallographer René Haüy in Paris. Seybert acquired a substantial study collection of minerals, which he kept in a specially built mahogany cabinet. He continued to add to his collection upon returning to Philadelphia, where he became the local authority on minerals.</p> <p>During the year of its founding in 1812, the Academy scraped together funds to acquire the Seybert mineral collection. Seybert sold the collection to the Academy for a staggering $750, but he continued to work on it and went on to prepare a handwritten catalog. The collection of more than 2,000 specimens remains at the Academy and is the oldest intact collection of minerals in the United States, containing more than 90 percent of all known minerals. It includes scientifically significant minerals, vials of ash and sulfur, and the only known minerals collected on the Lewis and Clark Expedition.</p> <p>The minerals are now housed in a modern cabinet in our Mineralogy Collection, and antique-furniture conservator Alan Andersen has restored the empty cabinet, on display in the Academy's library. </p><p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.

<i>This cabinet originally held the Seybert Mineral Collection. Photo by Alan Andersen, courtesy of ANSP.</i></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right"

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<i>John James Audubon and Alexander Wilson (Image courtesy of ANSP)</i></p><p>Scotland native Alexander Wilson (1766–1813), the father of American ornithology, arrived in New Castle, Delaware, in 1794 to seek a better life. Eight years later, he met American naturalist and member William Bartram, who encouraged Wilson to begin observing and painting birds. Between 1808 and 1814, Wilson's great nine-volume work,<i> American Ornithology</i>, was published.</p></p> <p>John James Audubon (1785–1851) was born in Haiti and at the age of 18 was sent to America in part to escape conscription into the Emperor Napoleon I's army. He had a great interest in birds, nature, and drawing, and he turned his passions into a deep study and collection of birds. Audubon is best known for his work <i>The Birds of America</i>.</p> <p>While these men helped secure Philadelphia as the birthplace of American ornithology, they share yet another link as contributing members of the Academy of Natural Sciences! </p><p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p> </p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0"

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<i>Portrait of Thomas Say by Charles Willson Peale (Image courtesy of the Ewell Sale Stewart Library & Archives, Coll. 286)</i></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>Coyote (</i>Canis latrans<i>) from John James Audubon's </i>The Viviparous Quadrupeds of North America<i> (Image courtesy of the Ewell Sale Stewart Library & Archives)</i></p><p>Before the 1820s, trappers and travelers to the American West were

familiar with the coyote, but this animal remained unknown in the scientific sense until 1823, when Academy founder Thomas Say described it. Say encountered the coyote during a famous journey known as the Long Expedition. Often called prairie wolves, these animals “are by far the most numerous of our wolves, and often unite in packs for the purpose of chasing deer,” wrote the expedition's chronicler, Edwin James. He named the animal <i>Canis latrans</i> (barking dog) in reference to its distinct call. To the dismay of Say and his fellow explorers, these creatures frequently ventured close to the expedition's encampments but proved exceptionally difficult to catch.</p></p> <p>James explained that Say's colleague and fellow naturalist Titian Peale “constructed and tried various kinds of traps to take them,” but to no avail. Each morning Say and Peale would discover a host of coyote footprints telling them that the coyotes were interested in the bait but too crafty to be caught. In fact, one coyote actually dug underneath the trap and retrieved the bait. Ultimately, they trapped a coyote, but it was killed in the process.</p> <p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories. </p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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one of the largest and most dangerous pit vipers in the Western Hemisphere. This particular specimen also holds a special place in the history of homeopathy. It was donated to the Academy's collections in 1830 by a corresponding member, Constantine Hering, who was stationed in the Dutch colony of Surinam. Hering, born and educated in the German kingdom of Saxony, immigrated to the United States in 1833 and soon became a driving force in the establishment of this form of alternative medicine. He helped found the Philadelphia Medical College of Homeopathy in 1848. (This institution would later become Hahnemann Hospital and then part of the Drexel University College of Medicine.)</p> <p>This specimen is remarkable because it is the snake from which Hering extracted the venom he used to develop the homeopathic remedy called Lachesis. This remedy remains in wide use for a variety of ailments, especially those of the heart and circulatory system.</p> <p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.

<i>South American bushmaster specimen donated by Constantine Hering (Image courtesy of ANSP).</i></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2><img src="http://30.media.tumblr.com/tumblr_lr3tg5d0SQ1qbxf1zo1_250.png" width="64"

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<i>Illustrations from Morton's publication (Image courtesy of ANSP)</i></p><p>By the early nineteenth century, Academy members knew that fossils could provide information on the age of geologic formations in the United States. But before this potential could be realized, they had to learn more about American fossils.</p></p> <p>Academy member Samuel George Morton was the man for the job. In collaboration with Lardner Vanuxem, he published the <i>Synopsis of the Organic Remains of the Cretaceous Group of the United States</i> (1834). The pair had sought and examined invertebrate fossils from the eastern and southern states, enabling them to trace Cretaceous rocks from New Jersey to Louisiana and relate the fossils to similar forms in Europe. Thanks to the work of the Academy, American scientists had the information they needed to assess the age of geologic formations.</p> <p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories. </p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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Dana's shipmates didn’t know what to make of this gentleman. They “called him 'Old Curious,' from his zeal for curiosities.” In fact, they wondered why a gentleman “should come to such a place as California to pick up shells and stones.”</p> <p>“Old Curious”

turned out to be Academy member Thomas Nuttall, one of the most important naturalists of the day and a contributor to the Academy's collections. Nuttall was an English national who had spent most of his adult years in Philadelphia, at Harvard, or on one of his many travels throughout the United States. When Dana encountered him in California, Nuttall was returning from an expedition, which had taken him across the continent to the Pacific Northwest, Hawaii, and California.</p> <p>The Ewell Sale Stewart Library and Archives of the Academy of Natural Sciences houses many rare, beautiful, and important works on the natural sciences. Access these images through the Art Collections Guide.

Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.

<i>Thomas Nuttall (Image courtesy of ANSP)</i></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>Daguerreotype showing the interior of the Academy of Natural Sciences, ca. 1840, Ewell Sale Stewart Library & Archives, Coll. 9 (Image courtesy of ANSP)</i></p></p> <p>This image may be the earliest interior photograph taken in the United States and is almost certainly the first taken inside a museum. It’s a daguerreotype, a form of early photography developed by Louis Daguerre. Philadelphia inventor Paul Beck Goddard had dramatically enhanced this process a year after the French announced it in 1839. Exposure times were reduced from one hour to minutes.

This daguerreotype, taken by Academy member Goddard himself, features a teenage Joseph Leidy (center), who would later become one of the leading American scientists of his time. The young man seated on the right—known for his keen interest in natural history, chemistry, and phrenology (not to mention his writing talent)—is Edgar Allan Poe.

The Academy still is a haven for successful writers. To see some of our scientists’ work, visit <i>We Wrote the Book</i>, an exhibit located outside our Ewell Sale Stewart Library & Archives. The exhibit features a sample of the hundreds of books written by men and women with ties to the Academy of Natural Sciences. </p> <p>Click here to see this story online. To view the rest of the 200 tales, visit <a

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Exciting things are still happening in the Ewell Sale Stewart Library & Archives, located within our current building at 19th Street and the Benjamin Franklin Parkway. The Library is internationally recognized for its extraordinarily rare and historic books, journals,

art, artifacts, manuscripts, photographs, and the unique papers and research of Academy members and staff. It is open to visitors by appointment and offers a daily public showing of John James Audubon’s masterwork <i>The Birds of America</i>.</p> <p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories. </p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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members worldwide.

Exciting things are still happening in the Ewell Sale Stewart Library & Archives, located within our current building at 19th Street and the Benjamin Franklin Parkway. The Library is internationally recognized for its extraordinarily rare and historic books, journals, art, artifacts, manuscripts, photographs, and the unique papers and research of Academy members and staff. It is open to visitors by appointment and offers a daily public showing of John James Audubon’s masterwork <i>The Birds of America</i>.]]></value>

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<i>Plates I, IV, and XXII from "Ancient Fauna of Nebraska" (Image courtesy of ANSP)</i></p><p>Published in 1853, Academy naturalist Joseph Leidy's “Ancient Fauna of Nebraska” informed readers about the great paleontological treasures waiting to be uncovered in the American West. Written by Academy naturalist Joseph Leidy and published in the <i>Smithsonian Contributions to Knowledge</i>, this volume provided its author the opportunity to illustrate and fully describe his specimens.</p></p> <p>All of the fossils came from other explorers' expeditions to the Mauvaise Terres, or White River Badlands, of what is now South Dakota. Dating from

approximately 38 million years ago, the fossils represented previously unknown animals, including 15 species of mammals and five species of turtles. These included an early camel, two extinct species of rhinoceroses, brontotheres (thunder beasts), entelodonts (killer pigs), and oreodonts (ruminating hogs).</p> <p>In 1856, Leidy made the first report of dinosaur fossils in North America. Two years later, he reported on the skeleton of <i>Hadrosaurus foulkii</i>, a large dinosaur discovered in New Jersey which was the most complete dinosaur skeleton known at the time. </p><p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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of <a href="http://www.ansp.org/200/stories/ancient-fauna">ANSP</a>)</i></p><p>Published
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align=left>Joseph Leidy, the father of American Vertebrate Paleontology, did not limit his research to fossils. Two years before he described <i>Hadrosaurus foulkii</i>, the most complete dinosaur skeleton known in 1858, he identified heartworm, a serious parasitic disease that affects dogs and some other mammals. He described the culprit, a nematode worm, and named it <i>Filaria immitis</i>. (It was later renamed <i>Dirofilaria immitis</i>.)

Leidy related the circumstances leading up to the discovery: “Mr. Joseph Jones recently presented to me two specimens of the heart of the dog.” According to Leidy, one dog's heart contained five filariae (the long, thread-like adults). In the second dog, “the right auricle and ventricle, and the pulmonary artery in its ramifications through the lungs are literally stuffed with <i>Filariae</i>.” Leidy noted that the blood of the second dog contained “a great number of the young.”</p> <p>Leidy noted that the first dog had an appetite that was “voracious and insatiable, and notwithstanding he was abundantly supplied with food, he remained in a very lean condition.” The dog afflicted with the mass of worms “was always so thin as to resemble a skeleton.” Thanks to Leidy's identification of heartworm, scientists have created medications to treat it.</p> <p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.

<i>Joseph Leidy's illustration of a nematode parasite of the bullfrog (Image courtesy of the Ewell Sale Stewart Library & Archives, Archives Coll. 12 D box 4 vol. 5)</i></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0"

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Ten years later, an Englishman named Benjamin Waterhouse Hawkins offered to mount the skeleton if we let him make a copy for his Paleozoic museum planned for Central Park. (His museum was never built.) Academy members agreed, and in 1868, we unveiled the world’s first mounted dinosaur skeleton. The posture was a bit off and the skull was made up, but the exhibit was an instant sensation, drawing people from all over the world.</p></p> <p><p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p><p><i>Retouched photograph of B. W. Hawkins beneath his reconstruction of</i> Hadrosaurus foulkii<i> (Image courtesy of

the Ewell Sale Stewart Library & Archives, Coll. 803) </i></p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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of B. W. Hawkins beneath his reconstruction of</i> Hadrosaurus foulkii<i> (Image courtesy of
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<i>The affectionately nicknamed, Frankenmoose (Image courtesy of Erica Lucy)</i></p><p>Look closely at the Academy’s moose—the body belongs to one animal, and the antler rack belongs to another.

Back in the early 1930s, New York's American Museum of Natural History and Chicago's Field Museum had impressive moose mounts on display. The Academy wanted an equally outstanding specimen to show interested visitors! In 1933, Academy benefactor Nicholas Biddle traveled to Alaska in search of such a moose. The one he collected was very good, but its antlers were a tad smaller than the moose antlers at the other two museums.</p></p>
<p><p>The taxidermist commissioned to mount the moose, Louis Paul Jonas, and the Academy's Director of Exhibits, Harold Green, found a larger pair and secured them to the head of the moose. When the diorama opened in 1935, the Academy had the largest moose mount on display in North America.

Dioramas were elaborate productions involving adventurers, scientists, artists, and artisans. Ambitious and often arduous expeditions were

formed to obtain the animals and record information about their habitats. Contrary to popular perception, animals in the dioramas are not stuffed. Instead, they're mounted on an armature covered by a sculpted body of wire and plaster. The skin of each animal has been stretched over this armature.</p></p> <p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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points from Blackwater Draw, New Mexico. Bones from a fossil mammoth appear in the
background (Image courtesy of <a href="http://www.ansp.org/200/stories/ice-age-
discovery">ANSP</a>).</i></p></p>        <p>In 1932 a road construction crew encountered
large quantities of bison and mammoth bones while looking for gravel near Clovis, New Mexico.
Alerted to the news, Academy Curator of Geology and Paleontology Edgar B. Howard quickly
investigated. In 1936, Howard, other Academy staff, and experts from the University of
Pennsylvania Museum and the California Institute of Technology began excavation at the
Blackwater Draw site.</p>        <p><p>The site contained fossils from a variety of extinct
Pleistocene mammals, including horses, camels, bison, and mammoths. The site also contained
several pointy stone and bone tools that were from the same time period as the mammoth bones,
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thus making Blackwater Draw the first site to demonstrate that Paleo-Indians (the earliest Native Americans) lived alongside Ice Age mammals. The tools, called Clovis points, were found with the large mammal remains. The discovery of these points in extinct species led some researchers to propose that Clovis big-game hunters contributed to the mass extinction of several large mammals at the end of the Pleistocene.

Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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Cadwalader requested the aid of writer and skilled fisherman Ernest Hemingway for an
important research project in Cuban waters. The Academy's Chief Ichthyologist, Henry W.
Fowler, headed the Gulf Stream Marine Test of 1934–35, and Hemingway, who had become an
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August 1934, Fowler, Cadwalader, and Hemingway spent a month on Hemingway's boat the Pilar, catching, measuring, and classifying numerous catches. Correspondence between Cadwalader and Hemingway after the trip illustrates that the latter party's assistance enabled Fowler to more accurately classify the marlin of the Atlantic Ocean. More than 40 letters between Cadwalader, Fowler, and Hemingway are housed in the Academy's Archives, and the Academy's Ichthyology Collection houses several of Hemingway's game fish specimens.</p>

<p><p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>Ruth Patrick in a greenhouse housing artificial streams (Image courtesy of ANSP)</i></p><p>Eminent ecologists Robert MacArthur and E. O. Wilson presented their landmark paper "The Theory of Island Biogeography" in 1963. They proposed that the time at which the biodiversity of an island reaches equilibrium (a balance between the number of new species colonizing the island and those becoming extinct) is based on the distance of the island from the mainland and the size of the island itself. In other words, the bigger the island or the closer it is to the mainland, the greater the diversity of species that will inhabit the island. This theory would prove influential in the fields of conservation biology and protecting endangered species.</p></p> <p>Dr. Ruth Patrick, founder of the Patrick Center for Environmental Research at the Academy of Natural Sciences, conducted one of the first independent verifications of this influential theory in 1964. Her three sets of experiments involved diatom communities in natural and artificial streams. (Diatoms are a type of microscopic algae that have proven useful in environmental monitoring.)

One experiment compared diatom communities colonizing glass slides in comparable streams located in Maryland and the Caribbean island of Dominica. As Dr. Patrick predicted based on the island's isolation, diversity was substantially lower on the island. A second experiment tested the effects of "island size" (actually the size of glass slides) and the diversity of the upstream colonizing populations for two Pennsylvania streams. As expected, the diversity was higher per unit area on the larger slides and in the stream with the more diverse upstream colonizers. The third experiment used artificial streams to test the rate of colonization on equilibrium biodiversity. In this case, biodiversity was higher when more diatoms flowed through artificial

streams.</p> <p>Learn more about <a
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Academy or attend one of the <a href="http://www.ansp.org/adult-programs/environmental-
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<i>Ruth Patrick in a greenhouse housing artificial streams (Image courtesy of ANSP)</i></p><p>Eminent ecologists Robert MacArthur and E. O. Wilson presented their landmark paper “The Theory of Island Biogeography” in 1963. They proposed that the time at which the biodiversity of an island reaches equilibrium (a balance between the

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<i>A visitor explores the microscopic world in the Academy’s </i>Outside In<i>. Photo by Mike Persico.</i></p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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VIREO scientist Doug Wechsler returned to the area later to take more photographs of the jocotoco antpitta and other birds. See these amazing photos through the <a

href="http://vireo.ansp.org/">VIREO image bank at ansp.org.</p></p> <p><p>Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.

<i>Jocotoco, one of the threatened bird species protected in the Tapichalaca Reserve in the Ecuadorean Andes (Image courtesy of ANSP)</i></p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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width=425><BR><i>African Giant Snail (</i>Achatina fulica<i>) (Image courtesy of <a
href="http://www.ansp.org/200/stories/invasion">ANSP</a>)</i></p><p>One of the most
disruptive invasive species anywhere is the giant African snail, a large land snail that is native
toEast Africa. Sometimes introduced as a food source and sometimes farmed to produce
cosmetic creams, the giant African snail is spreading throughout southern and eastern Asia, the
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Pacific Basin, the West Indies, and South America. This snail has wreaked havoc on agriculture, tourism, and ecosystems. It also may transmit the rat lungworm, a type of parasitic roundworm. When the larvae of the rat lungworm are ingested through undercooked snails or contaminated water or vegetables, they can cause a type of meningitis that may lead to nervous system damage or, in rare cases, death in the very young, the old, or those with compromised immune systems.</p></p> <p>The United States Department of Agriculture (USDA) is working to protect the continental United States from invasion and is building strategies to prevent these snails from spreading to other countries. This program is centered in the USDA Animal and Plant Health Inspection Service’s National Malacology Laboratory at the Academy. The program utilizes the Department’s vitally important collections to identify suspect snails that are intercepted at American seaports and airports and throughout the world.</p> <p>What else can shells tell us about the creatures that inhabit them? Search the Academy’s Malacology Collection website to find out more about our scientists’ work.

Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2><img src="http://30.media.tumblr.com/tumblr_lr3tg5d0SQ1qbxf1zo1_250.png" width="64"

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<i>African Giant Snail (</i>Achatina fulica<i>) (Image courtesy of ANSP)</i></p><p>One of the most disruptive invasive species anywhere is the giant African snail, a large land snail that is native toEast Africa. Sometimes introduced as a food source and sometimes farmed to produce cosmetic creams, the giant African snail is spreading throughout southern and eastern Asia, the Pacific Basin, the West Indies, and South America. This snail has wreaked havoc on agriculture, tourism, and ecosystems. It also may transmit the rat lungworm, a type of parasitic roundworm. When the larvae of the rat lungworm are ingested through undercooked snails or contaminated water or vegetables, they can cause a type of meningitis that may lead to nervous system damage or, in rare cases, death in the very young, the old, or those with compromised immune systems.</p>]]></value>

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href="http://www.ansp.org/200/stories/diorama-digest">ANSP</a>)</i></p></p>        <p>One
goal of many of the early Academy diorama expeditions was to collect a "family group" of one
adult male, one adult female, and one juvenile to display in lifelike dioramas within the museum.
In the explorers' opinion, this composition would allow visitors to see the differences between
male and female members of the same animal group—even if it didn’t reflect the reality of
nature. When you visit the museum, make sure to check out the gorilla and sable antelope
dioramas, which provide good examples of these "family groups."</p>        <p>Can you pick out
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the spot reserved for the missing male okapi? Visit the Academy to find out!

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 Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.

<i>Turning the page of Audubon's </i>The Birds of America<i> (Image courtesy of ANSP)</i></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table

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<i>John Lundberg (left, with camera) and fellow ichthyologist Ramiro Royero examine a goliath catfish (</i>Brachyplatystoma filamentosum<i>) at a fish market in Ciudad Bolívar, Venezuela. Mark Sabaj Pérez (right, with fish) celebrates the successful “hogging” of a black driftwood catfish (</i>Trachycorystes <i>sp.) after a 20-minute, hand-to-fin struggle in the Simoni River, Guyana. (Image courtesy of ANSP)</i>

South and Central America have the richest freshwater fish faunas on Earth, with more than 5,440 species documented to date. In February 2011, Academy ichthyologists Dr. John Lundberg and Dr. Mark Sabaj Pérez traveled to Manaus, Brazil to deliver lectures about their explorations of tropical Latin American rivers. They spoke to the 900-plus-member Brazilian Society of Ichthyology. John spoke about his field career, which has focused on documenting previously unseen fishes of the deep river channels of the Brazilian Amazon and Venezuelan Orinoco. Mark discussed how he has fished widely to document fish assemblages and discover new species in the rivers, lakes, and swamps of Venezuela, Colombia, Peru, Brazil, Argentina, Guyana, and Suriname.</p> <p>During the last two decades, unprecedented advances have helped ichthyologists document and understand the diversity and distributional patterns of tropical fishes. Recent fieldwork in unexplored waters and challenging habitats continues to uncover undescribed species and distinct new forms. Studies of newly collected and preserved specimens have improved the state of “Neotropical” ichthyology; fossils are helping researchers understand how fish originated and evolved; and new technologies are improving our understanding of fish evolution and habitat.</p> <p>Are you interested in learning more about the work of Academy ichthyologists? Visit the Ichthyology Department at ansp.org.

Click <a

href="http://ansp.org/200/stories/chasing-fish">here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories. </p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>An artist's rendering of Peale (Image courtesy of Wikimedia Commons)</i></p></p> <p>In the winter of 1833, naturalist Titian Ramsay Peale and a young Academy volunteer spent time collecting three- to four-hundred moth cocoons to study what Peale called "the perfect insect," the Prometheus moth (<i>Saturnia Promethea</i>).

After studying the Prometheus moth for months, he found that cocoons were generally seen hanging from sassafras, spice wood, or swamp button wood trees. From May to June, the leaves on these trees are in prime condition for parent insects to use for cocoons and adequate sustenance.</p> <p>In his published research on the Prometheus moth, Peale describes the process in which a caterpillar transforms to a pupa or nymph, and then to the adult Prometheus moth. “The caterpillar casts its skin three or four times, increasing in bulk and brilliancy of colour with each change” (Peale, 1836, p. 3) before it secures itself to a sturdy leaf and branch to spin silk, creating a cocoon. Peale’s love of lepidoptera is evident when he affectionately refers to the caterpillar as a “little architect.”</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>Othniel Charles Marsh (left) and Edward Drinker Cope, Ewell Sale Stewart Library & Archives, Coll. 457 (via ANSP)</i></p><p>The rivalry between brilliant paleontologists Edward Drinker Cope and Othniel Charles Marsh dominated American science during the second half of the 19th century. Marsh and Cope’s relationship soured when Cope showed off his fossil of <i>Elasmosaurus</i>, a large marine reptile from the Late Cretaceous period, and Marsh pointed out that the vertebrae (backbones) were oriented backwards. After a sharp exchange they agreed to have Academy curator Joseph Leidy decide who was right. Leidy promptly removed the head from one end and placed it on what Cope had thought was the tail. Afterwards, Cope frantically tried to collect all copies of a recently printed publication that contained his erroneous reconstruction. Leidy exposed the error and attempted cover-up at the next meeting of the Academy of Natural Sciences.</p></p> <p>The rivalry between Cope and Marsh went from bad to worse. Although their race to discover and name new species

yielded many fossil discoveries, it drove both men to extremes. Cope’s rushed work was plagued by careless errors. Marsh often resorted to bribery and bullying in the pursuit of specimens. Their exchanges in print were filled with poisonous charges and countercharges of errors, distortions, and fraud. At first these exchanges were limited to scientific journals, but later they made their way to the newspapers.</p> <p>The Bone Wars between Marsh and Cope became so intense that Joseph Leidy veered away from his studies of vertebrate paleontology of the West. Learn how Leidy continued to develop a prolific career in other areas.

Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories. </p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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Herald</i>.</p><p>Cope was not only a famous paleontologist, but a herpetologist as well, who had made significant contributions in both fields. However, Cope was infamous for “making rapid assessments of fossils and for rushing his sometimes sloppily-written observations into print” (Davidson, 2002, p. 217). Some blamed Cope’s mistake on his carelessness, but Marsh thought his rival was downright incompetent. The biggest question that quickly cycled through the scientific world was how could Cope have made such a monumental error in reconstructing the seemingly obvious anatomy of <i>E. platyurus</i>?</p></p> <p><p align=center><img src="http://27.media.tumblr.com/tumblr_lv4l97UY8w1qbxf1zo1_500.png" border=1 width=400>
<i>Fossil remains of </i>Plesiosaurus macrocephalus<i> (Image courtesy of The Proceedings of the Academy of Natural Sciences of Philadelphia)</i></p><p>In Cope’s defense, no one had ever seen a specimen of <i>E. platyurus</i>. In fact, Cope’s fossils constructed the only known example of this genus and species. It was not only the type specimen, but the <i>only</i> specimen. The skull and vertebral column were found in completely different areas (near Ft. Wallace, Kansas), so Cope claimed that it was difficult to see the link between the two. In 1868, paleontology was a new science, and there were very few precedents set for scientists in the field. Cope himself was a fairly new student of the science, and had not had any formal training in paleontology or geology.</p></p> <p>When Marsh pointed out the mistake -- the skull of the specimen was incorrectly placed at the end of the tail instead of at the end of the vertebral column -- it is believed that Joseph Leidy, Cope’s mentor and Academy president (from 1882-1891), acted as mediator and ultimately determined that Cope’s construction of <i>E. platyurus</i> was incorrect. Cope quickly scrambled to retract his August, 1869 publications on the matter and resubmitted corrected copies of the documents with

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<i>Angelo Heilprin: Ewell Sale Stewart Library & Archives, Coll. 457 (via ANSP)</i> </p><p>In 1890, Professor Angelo Heilprin traveled to Mexico to study the geological and paleontological relations of the Cretaceous deposits of the country. The following is an excerpt from an archival document, provided by the Academy's librarian, Clare Flemming:</p></p> <p>"This expedition, the first official one of the Academy, included J. E. Ives, Roberts LeBoutillier, Witmer Stone and Frank C. Baker in the party. Arriving on the 22nd of February, they covered the territory of the northwestern part of Yucatan and the Mexican highlands in the vicinity of Orizaba. Natural history specimens were gathered and photographic records of the ecological conditions and the contours of the country through which they travelled, were taken. The short time spent in the field ended in June of 1890, but the resultant additions to the Academy's museum collections were great. Accounts of the results appeared in the Proceedings of the Academy for 1890. Two documents from the U. S. State Department are retained here, documents which paved the way for the party. Signed by James G. Blaine and Avery A. Adee."</p> <p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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greater part of Mexico" (p. 445), and the deposits are similar to those previously studied in Texas and other Gulf States
  The deposits studied are a part of the Middle and Upper Cretaceous series of the geologic scale
 Deposits from the Lower Cretaceous were not discovered as a result of the expedition. No “true” Lower Cretaceous beds exist in Texas or Arkansas. No marine deposits from the Lower Cretaceous have been found in the United States east of the Rocky Mountains.
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Deposits from the Lower Cretaceous were not discovered as a result of the expedition. No "true" Lower Cretaceous beds exist in Texas or Arkansas. No marine deposits from the Lower Cretaceous have been found in the United States east of the Rocky Mountains.
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assistant, she stumbled upon a natural history gem in the archives. Little was known about naturalist Samuel Rhoads, even though he played a pivotal role in both Haddonfield and Philadelphia's history.

Rhoads was born in Philadelphia and raised in Haddonfield, New Jersey. In 1913, when Rhoads acted as chairman for Haddonfield's bicentennial celebration, his eyes were opened to the town's rich history. This inspired Rhoads and two other Haddonfield residents to create a historical society for the town. The organization was created with the mission of studying "the History of the Borough of Haddonfield, the County of Camden and the state of New Jersey; the study of organizations, societies, families, individuals and events; the collection and preservation of articles of historic value; the establishment and maintenance of an historical library; and the publication, from time to time, of such historical information as may be deemed expedient."</p></p> <p><p align=center><img src="http://27.media.tumblr.com/tumblr_lwz2esJ2BI1qbxf1zo1_500.jpg" border=1 width=350>
<i>Samuel N. Rhoads (Image courtesy of Haddonfield Historical Society)</i></p><P>Since 2010, members of the Haddonfield Historical Society and the Academy of Natural Sciences have been campaigning to preserve the history of Boxwood Hall, the historic house museum that sits on the beautiful land that inspired Samuel Rhoads to study and collect animals, and later become one of the country’s foremost naturalists. Members of the Samuel Rhoads team also participated in a Preservation New Jersey campaign, titled “Someplace... Not ‘Anyplace.’” The campaign, focused on preserving “special landmarks and places with historic character” (Preservation New Jersey, 2011), inspired those who were fighting for the preservation of Boxwood Hall.</p></p>

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<i>Samuel's supporters for the Preservation New Jersey campaign, "Someplace... Not 'Anyplace'" (Image courtesy of Haddonfield Historical Society)</i></p><p>The Historical Society houses some of Samuel’s field journals, childhood drawings, professionally published articles, and published books. As he began to collect more seriously, he sent his specimens to the Academy of the Natural Sciences for safekeeping. Even after Samuel’s health began to fail him in the late 1920s, his wife kept correspondence with Academy president Witmer Stone, not only to continue adding specimens to the growing ornithology collections, but to keep the family friend updated on Samuel’s health. His specimens are still kept in the Academy’s collections today.</p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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history gem in the archives. Little was known about naturalist Samuel Rhoads, even though he played a pivotal role in both Haddonfield and Philadelphia's history.

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<i>The indigo bunting Mrs. Mary Stone donated to the Academy, May, 1925 (Image courtesy of Kim Custer & The Academy of Natural Sciences' Ornithology Department)</i></p></p> <p>When Samuel collected specimens near his home in

Haddonfield, he would always place the specimens he wanted to donate to the Academy on his back porch. </p> <p>One morning in 1925, Samuel's wife, Mary, found a dead indigo bunting on a chair on the back porch. Unsure of whether the bird "got there of its own accord or whether Mr. Rhoads picked it up and put it there" with the intention of donating it to the Academy, Mary sent the bunting to Academy president, Witmer Stone. The note that accompanied the specimen updated Stone on Rhoads declining health. Mary said the couple had been ordered by the doctors to go to the Poconos or on a southern vacation to alleviate Samuel's lethargy, and poor sleeping and eating. In the next letter to Stone, Mary said, "I am glad the indigo bird was preserved and wonder if I will ever learn how it got under a piece of carpet on my back porch."</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>A photo of Rhoads' encampment. A handwritten caption on the back of the photo says, "Last camp at Mt. Major on Hardy Riv." (Image courtesy of the Ewell Sale Stewart Library & Archives, Coll. 421)</i></p><p>In 1905, Rhoads traveled West to collect bird and mammal specimens for the Academy. Upon reaching Yuma, Arizona, Rhoads was led by a

string of local guides to the Colorado River, about ten miles above the Gulf of California. Despite the miserable, rainy weather and low temperatures, Rhoads observed and hunted nearly 100 types of birds. Among his collected specimens was a family of Rock Wrens (<i>Salpinctes obsoletus</i>). </p></p> <p><p align=center><img src="http://25.media.tumblr.com/tumblr_lxyiaykRmP1qbxf1zo1_500.jpg" border=1 width=300>
<i>Rhoads' Rock Wren family, still lying side by side (Image courtesy of Kim Custer & the ANSP Ornithology Department)</i></p></p> <p>In the <i>Proceedings of the Academy of Natural Sciences</i> (a publication created by the Academy), Rhoads spoke fondly of the family, acknowledging the sacrifice they made to contribute to science: “... a wonderful family. Its life history, who can tell it? Sprite, sylph, orpheus of the barren mountains, what man could put thy likeness on paper or reveal to the reader thy inmost life? Now that the quest is over and I see seven skins lying side by side in the tray named and numbered, I trow they will be the last of that happy family to serve the demands of science” (Stone, 1905, p. 686).</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>A photo of Rhoads' encampment. A handwritten caption on the back of the photo says, "Last camp at Mt. Major on Hardy Riv." (Image courtesy of the Ewell Sale Stewart Library & Archives, Coll. 421)</i></p> <p>In 1905, Rhoads traveled West to collect bird and mammal specimens for the Academy. Upon reaching Yuma, Arizona, Rhoads was led by a string of local guides to the Colorado River, about ten miles above the Gulf of California. Despite the miserable, rainy weather and low temperatures, Rhoads observed and hunted nearly 100 types of birds. Among his collected specimens was a family of Rock Wrens (<i>Salpinctes obsoletus</i>). </p>]]></value>

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put thy likeness on paper or reveal to the reader thy inmost life? Now that the quest is over and I see seven skins lying side by side in the tray named and numbered, I trow they will be the last of that happy family to serve the demands of science” (Stone, 1905, p. 686).]]></value>

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<i>Rhoads' rail pass for the train in Ecuador (Image courtesy of Kim Custer at the Haddonfield Historical Society)</i></p><p>Rhoads and his team traveled by train, taking trips through the Andean mountains in western Ecuador. Every so often, the team would get off the train and descend into the wilderness, searching for birds. Rhoads and his guide would use the train tracks as the spine of their expedition, never straying too far, knowing they could hop on the train again if they needed to.</p></p> <p><p align=center><img src="http://30.media.tumblr.com/tumblr_ly0a8mYjTC1qbxf1zo1_500.jpg" border=1 width=400>
<i>Rhoads' </i>Ramphomicron stanleyi<i> (Image courtesy of Kim Custer and the ANSP Ornithology Department)</i></p><p>Ecuador proved to be an ideal place for hummingbirds. In the prestigious ornithology journal, <i>The Auk</i>, Rhoads chronicled his journey and admired the many species of hummingbirds that lived in the treeless Paramo area in the Andean mountains. The dark Thorn-bill (<i>Ramphomicron stanleyi</i>), he said, “feeds in a dainty, topsy-turvy fashion on the alpine crocuses and dwarfed heaths, which, near the snow line, have absolutely no stems but just bloom at the surface of the sand and ash. It is ‘heels-over-head’ with these Hummers and they can take the turn with wonderful grace, seeming to be walking from flower to flower on their bills” (Rhoads, 1912, p. 148). Rhoads delighted in his work, finding the beauty in each metallic green feather or peacock blue tail, every low, ghostly whistle or shrill, high-pitched cry from the birds he studied.</p></p> </blockquote>

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Dolan, B. (1938) Zoological results of the second Dolan expedition to Western China and Eastern Tibet, 1934-1936. Part I,--Introduction. <i>Proceedings of the Academy of Natural Sciences</i>, 90, 159-184.</p> <p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2><img

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<i>Brooke Dolan II: Ewell Sale Stewart Library & Archives Coll. 457 (via ANSP)</i></p><p>On May 10, 1934, the S. S. President Coolidge brought Brooke Dolan and his wife to Shanghai, China, for the beginning of an 18 month-long expedition through Western China and Tibet.

Ornithologist Ernst Schäfer arrived a week later, and Marion Duncan, who was to be in charge of supplies, transport, and communication with the Chinese and Tibetan people, arrived in June. After leaving Shanghai, Dolan’s crew was supplemented with three local boys from Chungking, who served as "No. 1 boy," bird skinner, and cook (Dolan, 1938, p. 163). Dolan’s mother joined them in late July.</p></p> <p>The goals of this expedition, outlined by Dolan himself, were (1) to secure systematic collections of Khams and high Tibetan fauna, (2) to obtain the large mammals of Tibet for the erection of life groups in the Academy's Museum, (3) to unravel the problem of the large Cervidae of the East Tibetan border, and (4) to explore the Eastern and Southeastern slopes of the great snow-range Amnyi Machen in Kokonor (Dolan, 1938, p. 159).</p> <p>This 1934 expedition was a continuation of a 1931 trip to Western China and Eastern Tibet. Dolan's chief purpose was to continue the systematic collections of mammals, birds, and land shells while studying the environment as they trekked from Shanghai to Batang.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>Specimens from Dolan's trek, courtesy of the 2011 Sportsman's Dinner at ANSP</i></p></p> <p>Despite setbacks from an early August monsoon and mud slides in September, Dolan and his team began collecting bird specimens in Chengtu, the fifth city on their expedition, just over a thousand miles away from their starting point in Shanghai. On the road from Chengtu to Tachienlu, two young goral (<i>Naemorhedus goral griseus</i>) were shot and captured by Schäfer. This success marked the beginning of the “serious mammal collecting,” which continued as the researchers trekked through Tachienlu, collecting a series of Tibetan takin (<i>Burdorcas tibetana</i>), a serow (<i>Capricornis sumatrensis milne-edwarsii</i>), a blue sheep (<i>Pseudois nayaur szechuanensis</i>), and a white-lipped deer (<i>Cervus albirostris</i>).</p> <p><p align=center><img src="http://27.media.tumblr.com/tumblr_lu3hywoBVw1qbxf1zo1_500.jpg" border=1 width=420>
<i>Dolan's specimens are still used today as a way to compare change over time. Here, birds from the 1930s lay next to Dr. Nate Rice's specimens from the 2000s (Image courtesy of ANSP)</i></p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2><img src="http://30.media.tumblr.com/tumblr_lr3tg5d0SQ1qbxf1zo1_250.png" width="64"

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<i>Dolan's expedition valise and specimens (Image courtesy of the Academy of Natural Sciences' Annual Sportsman's Dinner)</i></p></p> <p><p>From Tachienlu, the explorers hunted through Litang, where they collected “gazelles, cranes (<i>Grus nigricollis</i>), black stork (<i>Ciconia nigra</i>), lammergeier (<i>Gypaetus barbatus aureus</i>), many larks, pipits, and passerines between September 26 and October 15” (Dolan, 1938, p. 165), in addition to large deer and a stag.

The team “crossed the principality of the Yura Bonbo in company with several merchant caravans banded together for protection against raiders from Shangcheng" (Dolan, 1938, p.165) on their way to Batang, an arid region with a rich agricultural valley.</p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2><a

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We four men of the party of the American expedition to China, Marion Duncan, Brooke Dolan, Americans, Ernst Schafer, German agree: -- the magistrate of Jyekundo is not responsible for our safety or for the lives or property of ourselves or our men on the road across Chinghai to Hsining. Lee Yu Su, Chinese (Chungking) agrees. We acknowledge he has requested us to return to Szechuan, he has advised we do not go thru [sic] Chinghai. Our Nanking passports do not give us specific right to travel in Chinghai, and the magistrate cannot help us in any way. If robbers, tibetans, or Ngoloks rob or

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<i>A snapshot from Dolan's 1941 exhibit at the Academy, featuring specimens from his second expedition to Tibet & China (Image courtesy of the Ewell Sale State Library, Coll. 64, Box #2, Folder #7)</i></p></p> <p>It was only a few days before Jyekundo soldiers found Dolan and the expedition with news from the magistrate: they were ordered to return immediately to Jyekundo. Dolan and his team refused the orders and continued on. Two days later, another order came, and Dolan decided to find his way around the government's

demands.

Disguised as a Chinese merchant, Dolan traveled 400 more miles towards Sining, while Duncan and Schafer returned to Jyekundo. Although he did not make any new collections, Dolan was able to survey new land. Duncan and Schafer successfully gathered large bird collections, McNeill's deer, rare eared pheasants, and steppe bears. Upon returning to Nanking, Dolan decided to finally make the trek back home to Philadelphia.</p> <p>Home safe and sound just after Christmas, 1935, Dolan's second expedition was deemed a success. The collection from this expedition included 310 mammal specimens, large and small, 2615 bird specimens, and 2600 mollusk specimens. The expedition lasted for fourteen months and covered 3,000 miles. The team achieved their goals, with the exception of finding the ever-elusive leopard and snow-leopard. Exploring the field of Khams and lower Chinghai was one of the most ground-breaking parts of the expedition. These areas had not been explored much by zoologists, making Dolan and his team legendary.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<a href="http://www.ansp.org/200/stories/the-academy-in-the-field">ANSP</a>)</i></p>When
he first set eyes on Lake Hovsgol during the summer of 1994, Clyde Goulden knew it was
special. Also known as Hövsgöl Nuur, Lake Hovsgol is located near Mongolia's northern border
with Russia. It's nearly 85 miles long, more than 800 feet deep, and among the oldest lakes in the
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swimming 30 feet below its surface. Locals refer to it as the “blue pearl.”</p></p>
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<p>Clyde, an aquatic ecologist at the Academy's Patrick Center for Environmental Research, had spent decades studying lakes. He realized immediately that Hovsgol offered a unique opportunity to study an unspoiled environment. In 1995, Clyde led Academy and Mongolian scientists and other experts to study the lake's biodiversity and limnology. That same year, the Academy of Natural Sciences founded The Institute of Mongolian Biodiversity and Ecological Studies (which eventually became the present-day Asia Center) to support research at the lake.</p> <p>Academy scientists are hard at work studying climate change and working to overcome environmental challenges in Mongolia. Learn more about their work at asia.ansp.org.

Click here to see this story online. To view the rest of the 200 tales, visit ansp.org/200/stories.</p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>Mongolian researchers and students discuss steppe ecology at the Hovsgol Long-Term Ecological Reseach Site in Mongolia (Image Courtesy of ANSP).</i></p><p>In 1997 Mongolia's government established a network of Long-Term Ecological Research Sites (LTERS) to address its concerns about environmental protection, sustainable economic development, and climate change. Already the subject of considerable study by the Academy's Dr. Clyde Goulden and colleagues, Hovsgol National Park became the first site in this network and one of the first Asian LTERS in an international network of similar research sites. Research at Hovsgol includes surveying insects, monitoring forest regeneration, and assessing climate change impacts including the dynamics of thaw of permafrost.</p></p> <p>Programs at Hovsgol also are geared toward the training and professional development of Mongolian scientists. Ariuntsetseg Lkhagva is a striking example of a Mongolian scientist who prospered after she began work at Hovsgol in 2002. She has received an International Fulbright Science and Technology Award and is pursuing a doctorate in botany at the University of Wyoming. Her research in rangeland ecology may help us understand how pastures respond to overgrazing and the alteration of rainfall patterns associated with climate change.</p> <p>Click <a href="http://www.ansp.org/200/stories/capacity-building-at-

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The fossils that Ted and his colleagues have uncovered are improving our understanding of the evolutionary transition from finned fish to limbed animals (tetrapods). During a trip to the region in 2004, Ted and his colleagues made the spectacular discovery of <i>Tiktaalik roseae</i>, a 375-million-year-old fossil lobe-finned fish with many

features only seen in tetrapods. <i>Tiktaalik roseae</i> is the best example of the evolutionary transition between finned and limbed animals.</p></p> <p><p align=center><img src="http://25.media.tumblr.com/tumblr_m3yyocz7R91qbxf1zo1_500.jpg" border=1 width=400>
<i>Paleontologists work at the site in Nunavut where Tiktaalik was discovered. (Image courtesy of ansp.org)</i></p></p> <p>Read Ted’s blog to learn how he prepared for the trip, survived the climate, and searched for fossils in an area that resembles Mars! To learn more about the new discoveries made by Ted and his team in 2011, click here. To view the rest of the 200 tales, visit ansp.org/200/stories.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>A rendering of the "new" fish by the Academy's Jason Poole (Image courtesy of Jason Poole/ANSP)</i></p></p> <p>Research was funded by the National Science Foundation and the National Geographic Society. The team that made the discovery was the same that found <i>Tiktaalik rosae</i> on Ellesmere Island just a few years ago. Both specimens, "creatures close to tetrapod ancestry" (Switek, 2011), were found in the same place, making Ellesmere an important research site for paleontologists interested in the evolution of sea- to land-dwelling animals.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right"

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Sabaj, M. H. (2004). All Catfish Species Inventory, Trans-Continental Expedition, Peru. Retrieved from http://silurus.acnatsci.org/ACSI/field/Peru2004/1index.html#</p> <p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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<i>Mark Sabaj Perez (far right) and his team, taking samples in Quillabamba
(Image courtesy of Mark Sabaj Perez/<a
href="http://silurus.acnatsci.org">ACSI)</i></p></p> <p>The Academy's Collection
Manager of Fishes, Dr. Mark Sabaj Perez, has participated in 25 expeditions associated with a
project funded by the National Science Foundation called the <a
href="http://silurus.acnatsci.org">All Catfish Species Inventory (ACSI). The project was
one of four flagship projects in the Foundation’s Planetary Biological Inventories (PBI) program,
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diversity of life on Earth before much of it is lost. The goals of the ACSI are to "facilitate the
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consortium of taxonomists and systematists" (ACSI,
2011).</p> <p>The expeditions have brought him to 11 countries in North America, South
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<i>A photo of the Pisco River Valley in Peru (Image courtesy of Mark Sabaj Perez/ACSI)</i></p></p> <p>They traveled from Lima, across the southern region of the country to Assis Brasil on the opposite bank. The team spent just over a month sampling 58 cites, 54 of which produced collections of nearly 6,000 specimens.

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<i>Dr. Ilves (center) and her team in the Bahamas (Image courtesy of Dr. Katriina L. Ilves, Chaplin Postdoctoral Scientist, ANSP)</i></p><p>In 2010, Ilves' field research team included Mr. Gordon Chaplin, historical expedition participant and Academy benefactor, Dr. Mark W. Westneat, Ichthyologist from the Field Museum of Natural History, Dr. Ron I. Eytan, Ichthyologist from the University of Georgia, Dr. Heidi Hertler, environmental scientist at the School of Field Studies, and Dr. Riivo Ilves, field assistant.</p></p> <p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>

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Subsequent expeditions in 2006 and 2010 by Academy-affiliated scientists and Charles Chaplin's son Gordon to some of the historical sites around New Providence Island were conducted to replicate the sampling of decades past.</p></p> <p><p align=center><img src="http://25.media.tumblr.com/tumblr_lr3xne5Bqh1qbxf1zo1_500.jpg" width=400 border=1>
<i>Sampling fish back in the lab (Images courtesy of Dr. Katriina L. Ilves, Chaplin Postdoctoral Scientist, ANSP)</i></p></p> <p>The team observed an increase in both algal cover and dead coral by analyzing the 2006 collections, and the abundance of herbivorous species (those that feed on algae) also increased. The coral structure, however, had not collapsed, and therefore the community structure of the reef fishes has not drastically changed. These results are published in the July 2011 issue of the journal <i>Bulletin of Marine Science</i>. The data from the 2010 expedition, led by Dr. Ilves, are still being analyzed but qualitatively, the corals looked healthier in many locations than they did in 2006.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%"

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sampled were in very shallow water with a lot of surge – an environment that is not favored by this species. However, four lionfish individuals were collected, and their stomach contents will be analyzed in conjunction with stomachs from other lionfish specimens collected around the Caribbean.

Dr. Ilves' primary research interests are in the evolution of fishes, including the evolutionary relationships (systematics) and the geographic patterns of genetic diversity (phylogeography). The 2010 expedition had a major focus of collection tissue samples for future genetic studies, and over 1,500 such samples across ~200 species were collected!</p> <p><p align=center><img src="http://29.media.tumblr.com/tumblr_lrxrrb8Qb21qbxf1zo1_500.png" border=1 width=400>
<i>Examining & labeling the fish above water (Images courtesy of Dr. Katriina Ilves, Chaplin Postdoctoral Scientist, ANSP)</i></p></p> <p>These samples will be analyzed in conjunction with Caribbean-wide samples collected by Dr. Carole Baldwin, a collaborator at the Smithsonian Institution. We are particularly interested in disentangling the evolutionary relationships of groups of soapfishes (<i>Rypticus</i> spp.), cardinalfishes (<i>Apogon</i>, <i>Astrapogon</i> & <i>Phaeoptyx</i> spp.), and gobies (<i>Coryphopterus</i> spp.), and looking further into the geographic distribution of these species to test hypotheses about their evolution.</p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2><img src="http://30.media.tumblr.com/tumblr_lr3tg5d0SQ1qbxf1zo1_250.png" width="64"

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<i>(Image courtesy of Dr. Nate Rice, Ornithology Collections Manager, ANSP)</i></p></p> <p>Researchers have to keep meticulous records. All of this information is useful not only to Dr. Rice, but to his colleagues at the University of Kansas. Because scientists don’t know much about bird life in northern Vietnam, Nate's team conducted research on species common in the region and their habitats. The team discovered some species never recorded in Vietnam, uncovered new regional records, and studied the behavior of poorly known species. They also gathered specimens and tissue samples for analysis.</p> <p></p> </blockquote> </td> </tr> <tr> <td> <table width="100%" border="0" cellpadding="0" cellspacing="0"> <tr> <td width="99%" align="right" valign="middle"> <table border="0" cellpadding="0" cellspacing="0"> <tr> <td align="right" valign="top"><h2></h2></td> </tr> </table> </td> </tr> </table> </td> </tr></table>]]></description>
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<i>(Image courtesy of Dr. Nate Rice, Ornithology Collections Manager, ANSP)</i></p></p> <p>Dr. Rice has kept a chart, recording specific details about each of the specimens collected in Vietnam, including:
Biological information: Genus, species, subspecies, sex, gonad measurements, mass, fat, body molt, stomach contents
Geographical information: Continent, country, province or state, county (if applicable), location, habitat, latitude, longitude, altitude
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Assistant Scientist & Section Leader, Watersheds and Systems Ecology
Expertise: Aquatic ecology and ecological and biophysical economics

Michelle Brannin
Staff Scientist, Watersheds and Systems Ecology

Jill Sybesma
Adult Programs Coordinator
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<i>Examining the first sample (Image courtesy of sen136 at flickr)</i></p><p>At the conclusion of the field trip, although there was not enough time to sort through each of the 9 samples that were taken, Jerry faciliatated a discussion on the pending results, asking participants to synthesize the data they had collected at that point. It seemed that the failing restoration structures allowed for more biodiversity in the macroinvertebrate population of the stream, even

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Appendix B

Educational Activity and Teacher Guide, Day 1

Day 1: Natural History

The first activity will be an introduction to natural history, natural history museums, and the purpose an institution like the Academy of Natural Sciences serves in the scientific world.

ABCD Objective Summary

With guidance and background information from the instructor, students will discuss and explore selected stories from the history of the Academy of Natural Sciences and complete the attached worksheet.

Earth Science Literacy Initiative "Big Ideas"

1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continously changing.
6. Life evolves on a dynamic Earth and continuously modifies Earth.

Pennsylvania State Education Standards

Standard Area – 3.1: Biological Sciences
Organizing Category – 3.1.C: Evolution

Grade Level – 3.1.6.C: Grade 6

- Standard - 3.1.6.C1: Differentiate between instinctive and learned animal behaviors that relate to survival.
    - Assessment Anchor - S6.B.2: Continuity of Life
        - Anchor Descriptor - S6.B.2.1: Explain how certain inherited traits and/or behaviors allow some organisms to survive and reproduce more successfully than others.
    - Assessment Anchor - S6.B.3: Ecological Behavior and Systems
        - Anchor Descriptor - S6.B.3.1: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

Grade Level - 3.1.7.C: Grade 7

- Standard - 3.1.7.C2: Explain why the extinction of a species may occur when the environment changes. Explain that mutations can alter a gene and are the original source of new variations in a population.
    - Assessment Anchor - S7.B.2: Continuity of Life
        - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

- Standard - 3.1.7.C3: CONSTANCY AND CHANGE Identify evidence drawn from geology, fossils, and comparative anatomy that provides the basis for the theory of evolution.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

- Standard - 3.1.7.C4: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

Standard Area – 3.3: Earth & Space Sciences
Organizing Category - 3.3.A: Earth Structure, Processes and Cycles

Grade Level – 3.3.6.A: Grade 6

- Standard - 3.3.6.A1: Recognize and interpret various mapping representations of Earth's common features
  - Assessment Anchor - S6.A.3: Systems, Models, and Patterns
    - Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

Grade Level - 3.3.8.A: Grade 8

- Standard - 3.3.8.A2: Describe renewable and nonrenewable energy sources
  - Assessment Anchor - S8.D.1: Earth Features and Processes that Change Earth and Its Resources
    - Anchor Descriptor - S8.D.1.2: Describe the potential impact of humanmade processes on changes to Earth's resources and how they affect everyday life.

Materials needed:

- computer with projector/projected screen for the instructor
- computer lab with 1 computer per student (each computer must have Google Earth already downloaded)
- Google Earth file: "Bicentennial"

• student worksheet

First 15-20 minutes of class:
Have students answer the following questions in full sentences or a coherent paragraph. Ask a few students to share.

- What is a natural history museum?
- Why is it important to study plant and animal life?
- Why is it important to study prehistoric plant and animal life?

After discussing natural history museums, ask students, "Have you ever been to a natural history museum? Which one? What was your favorite part?" Discuss for a few minutes.

Speak to students about the Academy of Natural Sciences:

- Define natural history: *the scientific research of plants or animals, leaning more towards observational rather than experimental methods of study*

- Define natural sciences: *a branch of sciences that seeks to find rules that govern the natural world by using scientific methods*

- Describe the ANSDU as a natural science & natural history museum *and* an active research institution

    - Have students define natural science/history museum
    - Have students define active research institution
    - Show images/website/part of GE file

- Ask students what they think is studied at ANSP
    - Go over the types of research (not in too much detail though, because that's for tomorrow! -- talk generally about the study of fish, birds, reptiles, dinosaurs, microscopic life, etc.) and collaboration that goes on in research (political, academic, etc.)

Last 25 minutes of class:
Have students comb the ANSP 200 stories section for interesting anecdotes. Ask them to read through at least ten of the stories highlighted in the Google Earth file. For each expedition/research endeavor/story, have them list **Who** the story is about, **What** discipline(s) is/are involved, **When** and **Where** the story took place, and **Why** the research was conducted, **Why** it was important then, and **Why** it is important to us now.

For homework:
Have students write a reflective, one-page essay on the importance of scientific research.

Name: ____________________________________ Pd.: _______________
Date: _________________

The Academy of Natural Sciences of Drexel University
Natural sciences, history, and more!

1. What is a natural history museum?

2. Why is it important to study plant and animal life?

3. Why is it important to study prehistoric plant and animal life?

Vocabulary

- natural history: ____
____
____

- natural sciences: ____
____
____

- natural sciences/natural history museum: ____
____
____

- scientific research: ____
____
____

- active research institution: ____
____
____

Types of Research
Use the space below to list or draw a map of different areas of scientific research. What specific areas do scientists study? List as many as you can!

The Academy of Natural Sciences' 200 Stories

Story 1
Title: ____
Who? ______________________
What? ______________________
When? ______________________
Where? ______________________
Why? ____
____
____
____

Story 2
Title: ____
Who? ______________________
What? ______________________
When? ______________________
Where? ______________________
Why? ____
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Story 3
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Who? ______________________

What? ______________________________
When? ______________________________
Where? ______________________________
Why? ____
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Where? ______________________________
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Story 7
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Who? ______________________________
What? ______________________________
When? ______________________________

Where? ______________________________
Why? ____
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Story 8
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Who? ________________________________
What? _______________________________
When? _______________________________
Where? ______________________________
Why? ____
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Appendix C

Educational Activity and Teacher Guide, Day 2

Day 2: Areas of Scientific Research

The activity for day 2 is an exploration of natural science research areas. This provides students with the opportunity to see what scientific research entails: everything from the methods scientists rely on to specific procedures for conducting research in the field. Students will explore websites of various natural science-related organizations and will gain a better understanding of what skills are needed to conduct scientific research.

ABCD Objective Summary

After exploring websites of various scientific organizations, students will be able to explain what scientific researchers do, by explaining the necessary training and skill-sets, the places where scientists work, and the types of interdisciplinary collaboration and cross-discipline research that occurs.

Earth Science Literacy Initiative "Big Ideas"

2. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
5. Earth is a complex system of interacting rock, water, air, and life.
6. Earth is continously changing.
9. Humans significantly alter the Earth.

Pennsylvania State Education Standards

Standard Area - 3.1: Biological Sciences
Organizing Category - 3.1.C: Evolution

Grade Level - 3.1.6.C: Grade 6

- Standard - 3.1.6.C1: Differentiate between instinctive and learned animal behaviors that relate to survival.
  - Assessment Anchor - S6.B.2: Continuity of Life
    - Anchor Descriptor - S6.B.2.1: Explain how certain inherited traits and/or behaviors allow some organisms to survive and reproduce more successfully than others.
  - Assessment Anchor - S6.B.3: Ecological Behavior and Systems
    - Anchor Descriptor - S6.B.3.1: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

Grade Level - 3.1.7.C: Grade 7

- Standard - 3.1.7.C2: Explain why the extinction of a species may occur when the environment changes. Explain that mutations can alter a gene and are the original source of new variations in a population.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

- Standard - 3.1.7.C3: CONSTANCY AND CHANGE Identify evidence drawn from geology, fossils, and comparative anatomy that provides the basis for the theory of evolution.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

- Standard - 3.1.7.C4: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.
  - Assessment Anchor - S7.B.2: Continuity of Life
    - Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

Organizing Category - 3.1.A: Organisms and Cells

- Standard - 3.1.8.A9: Compare and contrast scientific theories. Know that both direct and indirect observations are used by scientists to study the natural world and universe. Identify questions and concepts that guide scientific investigations. Formulate and revise explanations and models using logic and evidence. Recognize and analyze alternative explanations and models. Explain the importance of accuracy and precision in making valid measurements.
  - Assessment Anchor - S8.B.3: Ecological Behavior and Systems
    - Anchor Descriptor - S8.B.3.2: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

Standard Area - 3.3: Earth & Space Sciences
Organizing Category - 3.3.A: Earth Structure, Processes and Cycles

Grade Level - 3.3.6.A: Grade 6

- Standard - 3.3.6.A1: Recognize and interpret various mapping representations of Earth's common features
  - Assessment Anchor - S6.A.3: Systems, Models, and Patterns

- •Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

- Standard - 3.3.6.A6: MODELS/SCALES Describe the scales involved in characterizing the Earth and its atmosphere. MODELS/SCALES Create models of Earth's common physical features.
  - •Assessment Anchor - S6.A.3: Systems, Models, and Patterns
    - •Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

Grade Level - 3.3.7.A: Grade 7

- Standard - 3.3.7.A3: Explain and give examples of how physical evidence, such as fossils and surface features of glaciation support theories that the Earth has evolved over geologic time. Compare geologic processes over time.
  - •Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources
    - •Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.

- Standard - 3.3.7.A7: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.
  - •Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources
    - •Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.

Grade Level - 3.3.8.A: Grade 8

- Standard - 3.3.8.A6: CHANGES Explain changes in earth systems in terms of energy transformation and transport. MODELS Explain how satellite images, models, and maps are used to identify Earth's resources.
  - •Assessment Anchor - S8.A.3: Systems, Models, and Patterns
    - •Anchor Descriptor – S8.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts

Materials needed:

- computer with projector/projected screen for the instructor
- computer lab with 1 computer per student (each computer must have Google Earth already downloaded)
- Google Earth file: "Bicentennial"

First 10-15 minutes of class:
Lead a discussion with students about the areas of scientific study. Be sure to cover chemistry, biology, physics, environmental sciences, and Earth sciences.

Then, define the specific areas of study at the Academy's Center for Systematic Biology and Evolution: http://ansp.org/research/systematics-evolution/

- Ichthyology
- Malacology
- Ornithology
- Invertebrates
- Invertebrate paleontology
- Vertebrate paleontology
- Entomology
- Herpetology
- Botany
- Mammalogy

And the Patrick Center for Environmental Research: http://ansp.org/research/environmental-research/

- Biogeochemistry
- Ecology
- Ecotoxicology
- Hydrology

Have students take notes during the discussion, defining each discipline in their own words.

Next 15 minutes of class:
Have students will peruse the Google Earth file and fill in a T chart, matching various expeditions with their corresponding scientific discipline:

Expedition (Title, Year)	**Disciplines(s)**

Students should fill in the chart for all of the detailed expeditions (each in their own folder under "Places"), as well as for 5-10 of the expeditions described in the "200 Stories" folder.

Last 20 minutes of class:
Provide students with an online list (you may want to post these on a class website or send in an email to make it easy for students to just click the link instead of having to type it out) of the following links. Have students explore five of the following websites and complete the attached worksheet.

- ANSP Research: http://www.ansp.org/research/index.php
- Society of Vertebrate Paleontology: http://vertpaleo.org
- American Society of Ichthyologists & Herpetologists: http://www.asih.org/
- American Malacological Organization: http://www.malacological.org/index.php
- Ornithology.com's list of organizations: http://www.ornithology.com/organ.html
- BIRDNET: http://www.nmnh.si.edu/BIRDNET/
- Entomological Society of America: http://www.entsoc.org/
- Entomological Foundation: http://www.entfdn.org/education_links.php
- The Bug Club: http://www.amentsoc.org/bug-club/
- Botanical Society of America: http://www.botany.org/index.php
- American Bryological & Lichenological Society: http://www.abls.org/
- American Society of Plant Biologists: http://my.aspb.org/

Name: _________________________________ Pd: ____________
Date: __________________

Areas of Scientific Research

Using the list of scientific organizations provided, provide thoughtful responses to the following questions. Use the back of this sheet and additional paper to answer these questions.

1. Find the “About Us” or “Mission Statement” page for five of the websites. Make a bulleted list of some of these organizations’ important goals (for example: raising public awareness, education, studying diversity, publishing in professional journals, etc.).
2. Where do the organizations’ goals overlap?
3. How do you think these organizations work together?
4. Why is it important that these types of organizations work together?
5. From your reading, describe what kinds of skills scientists need.
6. Make a list of places that scientists can work, other than the Academy of Natural Sciences.
7. Visit http://ansp.org and describe one of the current research initiatives of the vertebrate paleontology department. Also include a list of the different disciplines involved in this research.
8. Visit http://ansp.org and describe one of the current research initiatives of the Patrick Center for Environmental Research. Also include a list of the different disciplines involved in this research.

Appendix D

Educational Activity and Teacher Guide, Day 3

Day 3: Traveling the World

This activity takes a deeper look at a specific expedition: the travels of Brooke Dolan in Western China and Eastern Tibet from 1934-1936. Dolan's work is of great importance to the Academy, and will remain one of the organization's most ground-breaking expeditions. The students will discuss the components of planning a research expedition before completing a worksheet that challenges their skills to read the virtual map provided by Google Earth. Students will also need to apply some mathematical skills to answer questions about measuring distances and area.

ABCD Objective Summary:
Students will discuss the components of planning a scientific research expedition by reading the account of Brooke Dolan. Using the pre-existing Google Earth file, students will use geospatial thinking and distance measurements to grasp the distance traveled.

Earth Science Literacy Initiative "Big Ideas"

1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continously changing.
6. Life evolves on a dynamic Earth and continuously modifies Earth.
9. Humans significantly alter the Earth.

Pennsylvania State Education Standards

Standard Area - 3.3: Earth & Space Sciences
Organizing Category - 3.3.A: Earth Structure, Processes and Cycles

Grade Level - 3.3.6.A: Grade 6

- Standard - 3.3.6.A1: Recognize and interpret various mapping representations of Earth's common features
  - Assessment Anchor - S6.A.3: Systems, Models, and Patterns
    - Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

- Standard - 3.3.6.A6: MODELS/SCALES Describe the scales involved in characterizing the Earth and its atmosphere. MODELS/SCALES Create models of Earth's common physical features.
  - Assessment Anchor - S6.A.3: Systems, Models, and Patterns

- •Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

Grade Level - 3.3.7.A: Grade 7

- Standard - 3.3.7.A3: Explain and give examples of how physical evidence, such as fossils and surface features of glaciation support theories that the Earth has evolved over geologic time. Compare geologic processes over time.
  - •Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources
    - •Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.

- Standard - 3.3.7.A7: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.
  - •Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources
    - •Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.

Grade Level - 3.3.8.A: Grade 8

- Standard - 3.3.8.A6: CHANGES Explain changes in earth systems in terms of energy transformation and transport. MODELS Explain how satellite images, models, and maps are used to identify Earth's resources.
  - •Assessment Anchor - S8.A.3: Systems, Models, and Patterns
    - •Anchor Descriptor – S8.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts

Materials needed:

- computer with projector/projected screen for the instructor
- computer lab with 1 computer per student (each computer must have Google Earth already downloaded)

First 15 minutes of class:

Before letting students open up Google Earth:

- demonstrate how to open up Google Earth and the “Bicentennial” Google Earth file
- demonstrate how to navigate through Google Earth (zooming in, zooming out, clicking and dragging, activating and deactivating layers)
- demonstrate how to use the ruler tool in Google Earth (see http://www.google.com/earth/learn/beginner.html#drawing-and-measuring)
- explain the worksheet as a scavenger hunt of sorts through the Google Earth file

Next 10 minutes of class:
Open the “Bicentennial” Google Earth file and find Brooke Dolan’s expedition (all of the placemarks are collected in a folder titled “1934-1936: Brooke Dolan, Western China & Eastern Tibet” in the lefthand “Places” menu). Speak about the process of planning a research trip by asking prompting questions. Discuss what it would have entailed to plan such an expedition.

Ideas for prompting questions:

- How do you think he prepared for the difference in culture?
- How much money do you think he brought?
- How do you think he decided who and what to bring with him?
- How did he know what the land or the weather would be like?
- How much do you think he decided to pack?
- How do you think Brooke Dolan and his team traveled through China, trekking thousands of miles?
- Dolan was 23 years old when he planned this trip all by himself. Can you imagine planning a trip all by yourself?
- What are the differences in planning a scientific expedition in the present compared to planning an expedition the 1930s?
- Think about the time zone difference… what is the time zone difference? Think about how long the voyage from Philadelphia to Shanghai was. How well do you think he adjusted to the time zone difference in China?

Next 25 minutes of class:
Have students complete the worksheet by exploring the “Bicentennial” Google Earth file. Students can work individually but may consult their peers for help.

Name: ________________________________ Pd: ____________
Date: __________________

Exploring Science
A Google Earth Activity

Open up the Academy "Bicentennial" Google Earth file. In the lefthand menu, find Brooke Dolan's expedition to Western China and Eastern Tibet. Read Brook Dolan's story and answer the following questions.

Part I: Brooke Dolan

1. What was the first city Brooke Dolan and his expedition visited? ______________________
2. How far did Dolan and his team travel from Shanghai to Chengtu? Use the Google Earth Ruler tool to measure the distance. Provide two different units of measurement (one must be miles or kilometers) : ________________________ = ________________________
3. Name the Chinese provinces the expedition probably traveled through from Shanghai to Chengtu:
   ____
   ____
   ____
   ____
   ____
   ____
   ____
4. Since you have already measured the distance from Shanghai to Chengtu, let us see how much farther the expedition had to travel...

   Measure the distance from Chengtu to Tachienlu: ________________________ miles
   Measure the distance from Tachienlu to Batang: ________________________ miles
   Measure the distance from Batang to Jyekundo: ________________________ miles
5. What was the ***total mileage*** of the expedition's journey through China and Eastern Tibet? ________________________ miles *(you can round up - no decimals necessary)*
6. How many times did Dolan take an expedition to Western China and Eastern Tibet? _____
7. Give the scientific and common names for three of the specimens Dolan collected during his expedition:
   ________________________ = ________________________
   ________________________ = ________________________
   ________________________ = ________________________

8. Why was the expedition stopped at Jyekundo? ___________________________________
____
____
____
____

9. What were the two animals Dolan and his team could not find? _________________________
____

10. How many total specimens did Dolan come back with? ______________________________

11. What hemisphere did Dolan travel in? Northern or Southern? Eastern or Western?
____

12. Measure the distances from

Shanghai to Tachienlu: ________________________ miles
Tachienlu to Jyekundo: ________________________ miles
Jyekundo to Nanking: ________________________ miles
Nanking to Shanghai: ________________________ miles

13. Use the distances from question #12 to estimate the area covered by Dolan and his expedition. Use the space below to draw the area covered. Show your work and circle your answer. *Don't forget units of measurement!*

Appendix E

Educational Activity and Teacher Guide, Day 4

Day 4: Research Over Time

The activity for day 4 is a study of the work of two ichthyologists at the Academy of Natural Sciences of Drexel University. This activity will highlight the importance of conducting research that can be compared to existing research from the same area, as well as generating a comprehensive catalogue of specimens for future scientific study.

ABCD Objective Summary:
Using information from the Google Earth file as a guide, students will discuss and explore two specific expeditions from the Academy of Natural Sciences and complete the attached worksheet.

Earth Science Literacy Initiative "Big Ideas"

1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continously changing.
5. Earth is the water planet.
6. Life evolves on a dynamic Earth and continuously modifies Earth.
9. Humans significantly alter the Earth.

Pennsylvania State Education Standards

Standard Area - 3.1: Biological Sciences
Organizing Category - 3.1.C: Evolution

Grade Level - 3.1.6.C: Grade 6

- Standard - 3.1.6.C1: Differentiate between instinctive and learned animal behaviors that relate to survival.
    - Assessment Anchor - S6.B.2: Continuity of Life
        - Anchor Descriptor - S6.B.2.1: Explain how certain inherited traits and/or behaviors allow some organisms to survive and reproduce more successfully than others.
    - Assessment Anchor - S6.B.3: Ecological Behavior and Systems
        - Anchor Descriptor - S6.B.3.1: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

Grade Level - 3.1.7.C: Grade 7

- Standard - 3.1.7.C2: Explain why the extinction of a species may occur when the environment changes. Explain that mutations can alter a gene and are the original source of new variations in a population.
  - •Assessment Anchor - S7.B.2: Continuity of Life
    - •Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

- Standard - 3.1.7.C3: CONSTANCY AND CHANGE Identify evidence drawn from geology, fossils, and comparative anatomy that provides the basis for the theory of evolution.
  - •Assessment Anchor - S7.B.2: Continuity of Life
    - •Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

- Standard - 3.1.7.C4: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.
  - •Assessment Anchor - S7.B.2: Continuity of Life
    - •Anchor Descriptor - S7.B.2.1: Explain natural selection and its role in evolution.

Organizing Category - 3.1.A: Organisms and Cells

Grade Level - 3.1.8.A: Grade 8

- •Assessment Anchor - S8.B.3: Ecological Behavior and Systems
  - •Anchor Descriptor - S8.B.3.2: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

Materials needed:

- computer lab with 1 computer per student (each computer must have Google Earth already downloaded)
- Google Earth file: “Bicentennial”
- Student worksheet

First 15 minutes of class:

Start by:

- giving a brief overview of what the class period’s assignment will entail

- having students read through the expeditions of Dr. Katriina Ilves and Dr. Mark Sabaj Perez in the Google Earth file

Next 5-10 minutes of class:
Begin a discussion about the two major themes in this research: comparing current data to historic research and comprehensive catalogue of specimens

Example prompting questions:

Dr. Ilves

- What is Dr. Ilves trying to do in her research?
- Why is it important to make a comparison of current data to historical data?
- What will a historical comparison show scientists who analyze the research?
- Why would results be different now compared to 50 years ago? (Quality of water, land, population increase in species & humans, different/more accurate equipment, how do animal populations affect plant populations and vice versa, etc.)

Dr. Sabaj Perez

- What project is Dr. Sabaj Perez a part of?
- What is the goal of the project?
- Why is it important to catalogue as many catfish specimens as the scientists can find? (Comparing species differences/similarities in the future, comparing differences/similarities in the habitats in the future, etc.)
- What kind of research can these specimens be used for in the future?

Next 20-25 minutes of class:
Hand out worksheets and allow students time to complete as much of the worksheet as they can.

Name: ___________________________________ Pd. ____________
Date: ____________________

What's history got to do with it?
An Exploration in Google Earth

Read through the expeditions of Dr. Katriina Ilves and Dr. Mark Sabaj Perez in the "Bicentennial" Google Earth file. Using what you've learned, answer the following questions about their research.

Dr. Katriina Ilves:

1. What are the two goals of Dr. Ilves' research in the Bahamas?
   - ____
   ____
   - ____
   ____

2. How are Dr. Ilves and her team going to determine if the reef fish community has changed over the past 50 years? ____
   ____
   ____
   ____
   ____

3. What is phylogeography? Explain in your own words: ______________________________
____
____

4. What kind of habitat do reef fishes live in? ___________________________________
   ____
   ____

5. What does "an increase in algal cover and dead coral" mean for the aquatic community?
   ____
   ____
   ____
   ____
   ____
   ____

6. What is an invasive species? (You will have to look it up – try http://accessscience.com.) Please explain in your own words:
   ____
   ____

7. Name some plants or animals that might be considered "invasive species" if they were introduced to our community:

____
____
____
____
____

8. Choose one of the plants or animals you listed above, and give examples as to how this species would disrupt our community. You may either write a comprehensive paragraph below or use the space to illustrate your answer. If you choose to draw, be sure to label all parts of the drawing.

9. Based on the photograph from the placemark titled, "Communities and Phylogeography," draw a picture of how the ichthyologists store and label their fish. Label each part of your drawing:

10. Brainstorm some reasons why the results of Dr. Ilves' study were different than Dr. Böhlke's.

Dr. Mark Sabaj Perez:

1. What is taxonomic research? (You will have to look it up – try http://accessscience.com.) Please explain in your own words:

____
____

2. How do you think Dr. Sabaj Perez and his team collected their catfish specimens?

____
____
____

3. Visit the ACSI website (the link is available in the placemark titled, "The All Catfish Species Inventory") and click on the link "Project Summary." Read through the "OVERVIEW" at the bottom of the page, and describe (in your own words) the importance of this research, why it is being done, and what it will produce.

- Some things to think about: how could this catalogue of specimens be useful in the future? Why is it important to collect every specimen of catfish? What kind of research could these specimens be used for once they are catalogued?

Appendix F

Educational Activity and Teacher Guide, Day 5

Day 5: Plan Your Own Expedition

The activity for day 5 is a group project in which students will plan their own scientific expedition. Students will agree on a specific discipline and topic within that discipline. They will need to find a location that adequately suits their research needs, and will then solidify a detailed plan for their expedition.

ABCD Objective Summary:
Using the previous activities as a knowledge base, students will work together in teams of three or four to plan a detailed trip abroad for scientific research purposes. Students will select a discipline, topic within the discipline, and a logical location for their research and proceed to research details related to their fictional trip.

Earth Science Literacy Initiative "Big Ideas"

1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continuously changing.
6. Life evolves on a dynamic Earth and continuously modifies Earth.
7. Humans depend on Earth for resources.
9. Humans significantly alter the Earth.

Pennsylvania State Education Standards

Standard Area - 3.1: Biological Sciences
Organizing Category - 3.1.A: Organisms and Cells

Grade Level - 3.1.8.A: Grade 8

- Standard - 3.1.8.A9: Compare and contrast scientific theories. Know that both direct and indirect observations are used by scientists to study the natural world and universe. Identify questions and concepts that guide scientific investigations. Formulate and revise explanations and models using logic and evidence. Recognize and analyze alternative explanations and models. Explain the importance of accuracy and precision in making valid measurements.
  - Assessment Anchor - S8.A.2: Processes, Procedures, and Tools of Scientific Investigations
    - Anchor Descriptor - S8.A.2.2.: Apply appropriate instruments for a specific purpose and describe the information the instrument can provide.

- •Assessment Anchor - S8.A.3: Systems, Models, and Patterns
  - •Anchor Descriptor - S8.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.
- •Assessment Anchor - S8.B.3: Ecological Behavior and Systems
  - •Anchor Descriptor - S8.B.3.2: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems.

Standard Area - 3.3: Earth & Space Sciences
Organizing Category - 3.3.A: Earth Structure, Processes and Cycles

Grade Level - 3.3.6.A: Grade 6

- Standard - 3.3.6.A1: Recognize and interpret various mapping representations of Earth's common features
  - •Assessment Anchor - S6.A.3: Systems, Models, and Patterns
    - •Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

- Standard - 3.3.6.A6: MODELS/SCALES Describe the scales involved in characterizing the Earth and its atmosphere. MODELS/SCALES Create models of Earth's common physical features.
  - •Assessment Anchor - S6.A.3: Systems, Models, and Patterns
    - •Anchor Descriptor - S6.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

Grade Level - 3.3.7.A: Grade 7

- Standard - 3.3.7.A3: Explain and give examples of how physical evidence, such as fossils and surface features of glaciation support theories that the Earth has evolved over geologic time. Compare geologic processes over time.
  - •Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources
    - •Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.

- Standard - 3.3.7.A7: Understand how theories are developed. Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. Describe relationships using inference and prediction. Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze quantity results of investigations. Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments, and are based on scientific principles, models, and theories. Analyze alternative explanations and understanding that science advances through legitimate skepticism. Use mathematics in all aspects of scientific inquiry. Understand that scientific investigations may result in new ideas for study, new methods, or procedures for an investigation or new technologies to improve data collections.

- •Assessment Anchor - S7.D.1: Earth Features and Processes that Change Earth and Its Resources
  - •Anchor Descriptor - S7.D.1.1: Describe Earth structures and processes that characterize different biomes on Earth.

Grade Level - 3.3.8.A: Grade 8

- Standard - 3.3.8.A2: Describe renewable and nonrenewable energy sources
  - •Assessment Anchor - S8.B.3: Ecological Behavior and Systems
    - •Anchor Descriptor - S8.B.3.2: Identify evidence of change to infer and explain the ways different variables may affect change in natural or human-made systems
  - •Assessment Anchor - S8.D.1: Earth Features and Processes that Change Earth and Its Resources
    - •Anchor Descriptor - S8.D.1.2: Describe the potential impact of humanmade processes on changes to Earth's resources and how they affect everyday life.

Grade Level - 3.3.8.A: Grade 8

- Standard - 3.3.8.A6: CHANGES Explain changes in earth systems in terms of energy transformation and transport. MODELS Explain how satellite images, models, and maps are used to identify Earth's resources.
  - •Assessment Anchor - S8.A.3: Systems, Models, and Patterns
    - •Anchor Descriptor – S8.A.3.2: Apply knowledge of models to make predictions, draw inferences, or explain technological concepts

Materials needed:

- Computer lab with 1 computer per student (each computer must have Google Earth already downloaded)
- Google Earth file: "Bicentennial"
- Student instructions

Put students into teams of 3-4 and go over the guidelines for the "Plan Your Own Expedition" assignment as a class, found in the worksheet.

Name: ______________________________ Pd.________
Date: ________________________________

Plan your own expedition!

For the student teams:

You are scientists getting ready for an expedition! You are conducting ground-breaking research and need to gather information about your expedition to present to your team. Each team will choose a scientific discipline, a topic to study, and a place where their team will travel. You will then develop a travel brochure to present to your team (the class) that explains all of the details of your trip.

Using your knowledge of scientific research, each team must:

1. Choose a discipline (for example: ichthyology, vertebrate paleontology, ornithology, etc.)
2. Find a topic of research within the discipline (for example: exotic fish, digging for fossils, collecting birds in Timbuktu, etc.), and select a logical location to conduct your research. This step will require some research on your part. What types of scientific research projects are being done? If you want to study exotic fish, where is the best place to do so? Work as a team to develop a plan for your research.
3. Work together to write a two-paragraph essay on what your research will entail. Be sure to include why you chose your location based on your discipline and the significance of your research. Why will your research be important to the scientific community? You can get ideas from your previous activities (the websites from Day 2's activity, the Academy's website, or anything from the Google Earth file).

The writing assignment must be complete before moving on to the travel brochure!

After you decide what type of research you will be conducting and where you will travel, you must create a travel guide or brochure for presentation. It should include the following:

- Identify a general location where your research can be conducted. Select a country and a specific city to travel to.
- Provide a map of the world location where your research will be conducted. Please indicate the closest city as well as the country. You must also include a resource for the map.

Plan the expedition!

Some things to consider and plan for the scientific team:

- Please research airlines and costs to the closet city to where your research will be conducted. Provide at least three different airline price quotes for the trip (if there are at least three different airlines that go there).

- What is the country where your research is going to take place like? What language do they speak? What is the common currency? (Check out https://www.cia.gov/library/publications/the-world-factbook/)
- Are there roads/other sorts of infrastructure (houses, electricity, etc.) near where you are planning to go? (You can use Google Earth to look at what it is like near their location).
- If the site is far away from civilization, how will you get the scientists there from the closest airport?
- What is the climate like where you are going? What time of year would be the best time to go?
- Who will you bring with you? Think big! An artist to draw your specimens? A photographer or videographer? Fellow employees from the Academy (check out the ANSP employees at the website: http://ansp.org)?
- What equipment will you need?
    - Think about the food, water and shelter needs. Will the scientists be able to buy food/water during the trip or will they have to bring it all with you?
    - What type of equipment will you need for your research?
    - How will you get the equipment to the site?
    - Will you be bringing specimens back? How will you store the specimens and transport them back to the airport from the site?

You may design your brochures on the computer or by hand. Take this class period time to conduct all of your research, then delegate tasks to each member of the group to do for homework. Be prepared to talk about any challenges you were faced with while creating your trip.

Most of all… have fun, scientists!

Sara Neville

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EDUCATION

The Pennsylvania State University, Brandywine Campus, Media, PA (2008 - 2012)

- Major: Bachelor of Philosophy, Minors: Environmental Inquiry, Civic Engagement
- Schreyer Honors Scholar (2010 - 2012), Jane E. Cooper Campus Honors Scholar (2008 - 2010)

HONORS THESIS

Two Hundred Years of Discovery: Using Google Earth to Raise Awareness of Scientific Research at the Academy of Natural Sciences of Drexel University (Spring 2012)

- Thesis Supervisor: Dr. Laura Guertin, Associate Professor of Earth Science
- Honors Adviser: Dr. Ivan Esparragoza, Associate Professor of Engineering

UNDERGRADUATE RESEARCH EXPERIENCE

Research Focus: Educational Technology & Curriculum Development (2009 - 2012)

- Identifying Global Ethical Issues: Case-Based Exercises for Introductory Level Engineering Design Classes
    - Research funded by The Leonhard Center for Enhancement of Engineering Education, The Pennsylvania State University: $1,400 grant, *Ethical Considerations in Global Design: Case Study Approach in EDSGN100*
- The Earth & Space Science QUEST (Questioning and Understanding Earth and Space Science Themes): http://tinyurl.com/earthspacequest
    - Research funded by the National Science Foundation, GEO-Teach Program: $4,000 grant, *Transforming Earth Systems Science Education*

VOLUNTEER/FIELD EXPERIENCE

Penn State Brandywine campus TEDxPSU event (Fall 2011)

- Co-coordinator for the event on campus

The Academy of Natural Sciences of Philadelphia (May - August 2011)

- Education department intern
- Curriculum development for “Ancient Animals,” a week of the Academy’s summer camps for ages 5-12

Tumblr #science tag (February 2011 - present)

- Community curator for the featured science content on Tumblr: http://tumblr.com/tagged/science

PSU Brandywine Honors Program Service Project (Fall 2010)

- Project coordinator
- Planting a Seed: Nutrition for Taggart Elementary School

PSU Brandywine Honors Program Service Project (Spring 2010)

- Social media chair
- We Are People, Not Property: Raising awareness of human trafficking

Ursuline Academy, Wilmington, DE & Gray Middle School, Union, KY (Spring 2010)

- Guest presenter, 8th grade Earth & space science
- Developed & taught: Scavenger Hunt in Google Sky, Water Quality Activity in Google Earth

Penn's Grove Middle School, Oxford, PA (Fall 2009)

- Student observer & guest presenter, 8^{th} Grade Earth Science
- Developed & taught: Volcano Activity in Google Earth

Great Valley Middle School, Malvern, PA (Fall 2009)

- Student observer, 6^{th} Grade Math

WORK EXPERIENCE

Great Valley Middle School, Malvern, PA (Fall 2006 - present)

- Assistant director, annual spring musical

CCMP Music Programs (Summer 2005 - present)

- Senior staff member, annual summer theater & music camps

PUBLICATIONS

Esparragoza, I.E., and Neville, S. 2011. Ethical Considerations in Global Design: Case Study Approach in EDSGN100. Report submitted to the Leonhard Center for Enhancement of Engingeering Education, p. 55.

Guertin, L.A., & S.E. Neville. 2011. Using Google Earth to teach students about global oil spill disasters. *Science Activities: Classroom Projects and Curriculum Ideas, 48*(1): 1-8.

Neville, S.E., & L.A. Guertin. 2011. Ten examples of utilizing existing gigapixel panoramas in the Earth and space science classroom. *The Earth Scientist,* 27(2): 46-49.

Neville, S.E., & L.A. Guertin. 2011. Three guided student explorations of Sky in Google Earth. *The Earth Scientist,* 27(2): 33-36.

Neville, S.E., & L.A. Guertin. 2009. Integrating Google Earth with the QUEST for Earth science literacy. *The Earth Scientist, 25*(4): 31-34.

PRESENTATIONS

Neville, S., & L. Guertin. 2011. Teaching STEM with Google Earth: Multidisciplinary Approaches to Geospatial Technology. International Society of Technology in Education (ISTE) Annual Conference, Philadelphia, PA, June 27, 2011.

Neville, S.E., & L. Guertin. 2011. Sky in Google Earth as a tool for student inquiry and exploration. Abstracts with Programs, Geological Society of America (Northeast/North-Central Meeting), 43(1): 79. Pittsburgh, PA, March 20, 2011.

Neville, S.E., L. Mookerjee, & L. Guertin. 2011. Uses of existing GigaPan images in the Earth and space science classroom. Abstracts with Programs, Geological Society of America (Northeast/North-Central Meeting), 43(1): 79. Pittsburgh, PA, March 20, 2011.

Neville, S.E. 2010. Integrating Google Earth with the QUEST for Science Literacy. The Council on Undergraduate Research's Posters on the Hill, Capitol Hill, Washington DC, April 13, 2010.

Neville, S.E., & L. Guertin. 2010. Taking Students on an Earth QUEST (Questioning and Understanding Earth Science Themes) with Google Earth. National Earth Science Teachers Association (NESTA) Share-a-thon presentation, part of the National Science Teachers Association (NSTA) conference, Philadelphia, PA, March 19, 2010. Presented by undergraduate author S. Neville.

Guertin, L., & S. Neville. 2010. Enhancing middle and high school student understanding of Earth system science through a Google Earth QUEST. Abstracts with Programs (Geological Society of America), 42(1): 132.

Guertin, L., S. Neville, & J. Hartline. 2010. The benefits of utilizing Google Earth as an undergraduate research tool for non-science majors. Abstracts with Programs (Geological Society of America), 42(1): 75.

Neville, S., & L. Guertin. 2009. Using a Google Earth QUEST to improve Earth science, reading, and geographic literacy. EOS Trans. AGU, Fall Meet. Suppl. Abstract ED53A-0533.

Guertin, L., & S. Neville. 2009. Adapting Google Lit Trips for the geosciences. Abstracts with Programs (Geological Society of America), 41(7): 499.

SCHOLARSHIPS & AWARDS

- Outstanding Volunteer Service Award for the National Collegiate Honors Council's Day of Service, Penn State Brandywine, Media, PA (Fall 2010)
- Undergraduate Researcher of the Year Award, Penn State Brandywine, Media, PA (2010)
- John D. and Greta C. Vairo Scholarship, Penn State Brandywine, Media, PA (2009 - 2011)
- Cooper Honors Program Scholarship, Penn State Brandywine, Media, PA (2008 - 2010)

CONFERENCES ATTENDED

- Pennsylvania Women's Conference, Pennsylvania Convention Center, Philadelphia, PA (October 2-4, 2011); selected as one of two students from campus to attend with Chancellor Sophia Wisniewska
- The FINE International Conference for Gigapixel Imagery, Carnegie Mellon University, Pittsburgh, PA (November 11-13, 2010)
- Invitation from the Council on Undergraduate Research to attend a Congressional Briefing on "Undergraduate Research and American Innovation," Capitol Hill, Washington, D.C. (October 26, 2010)
- TESSE: Transforming Earth Systems Science Education, funded by the National Science Foundation, Penn State Brandywine, Media, PA (August, 2009)

INTERNATIONAL TRAVEL

- Paris, France (November, 2010)
- Quebec City, Quebec, Canada (February, 2004)

SKILLS

- Intermediate proficiency in: Adobe Photoshop, Garageband, Gigapan, Google Docs, HTML coding, iMovie, Microsoft Excel, Spreadsheet Mapper
- Advanced proficiency in: Google Earth, Microsoft PowerPoint, Microsoft Word, social media (Blogger, Facebook, flickr, Instagram, Pinterest, Tumblr, Twitter)