Bridging the Generational Gap Through Natural History:
Using SUNY Purchase's Natural History Collections as an Educational Module for Senior Citizens and College Students

by

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Abstract

This paper examines the relationships between natural history collections (NHCs) and adult education. First, we describe the important roles that NHCs and their respective institutions have on topics such as biology, environmental science, education, climate change etc. I review the background of NHCs, their present role in society, how they are related to education, specifically senior citizens. Several challenges to using NHCs in education are presented as well as methods that can mitigate such obstacles. Through literature review and personal curatorial experience, I developed a conceptual program that can be adopted within the 'Broadview' senior living community on campus to further expand natural history collection knowledge, teach modern technological advancements and benefit SUNY Purchase College, Broadview Community and the public.

Introduction

"MUSEUMS HAVE A LONG HISTORY OF EDUCATING THE PUBLIC THROUGH INFORMAL AND NONFORMAL LEARNING, AND THE POWER TO CONFRONT INDIVIDUALS' SCHEMATA AND TRANSFORM THE WAY PEOPLE VIEW THE WORLD"- John Dewey

Natural History Collections are an often overlooked and misunderstood facet in the world of natural science. When the term 'NHC' comes up, most individuals visualize beautifully displayed dinosaur fossils, reconstructed Wooly Mammoth models, shrunken heads in jars and insects pinned to corkboard. Although these examples seem extreme, they aren't far from the truth, but novelty artifacts in large museums barely scratch the surface of what roles natural history collections (NHCs) and natural history museums (NHMs) play in the broader context of biological science and society. These collections and the contained specimens can provide centuries full of insight into trends in biodiversity, evolution, agriculture, public health and safety, invasive species and climate change.

NHCs play a vital role in education for both K-12 students, undergraduate students and senior-citizens with a desire to learn more about their environment, history and impact on the world. SUNY Purchase College's Department of Environmental Studies has recently uncovered an array of long-lost natural history specimens dating back over 50 years. If these items continued to degrade and be forgotten, decade's worth of valuable information may have been lost. Dr. Allyson Jackson, I and two other students re-organized, identified, cleaned, interpreted and displayed prized items from the collection in hopes of providing a story of the region's biodiversity.

This curation process coupled with the upcoming development of the 'Broadview' senior living community presented the perfect opportunity to integrate my curatorial/museum activities directly with the future Broadview residents. Collaboration between two very different demographics (young vs. old) may provide a mutualistic approach toward natural history collection education intertwined with new approaches for "successful aging" in these communities. This paper examines the relationships between NHCs as education modules and newly emerging methods and resources for assisted senior living on college campuses.

Roles of Natural History Collections

Natural history museums and collections are incredibly popular with the public, especially older generations with free time, a desire to learn and contribute to the world with their knowledge. Natural history collections provide insight into “base-line data” which comparisons can be made between current observations in efforts to devise predictive models (Guardian, 2011). Primarily, natural history museums and collections serve to preserve and protect “type specimens”, a biological nomenclature used in zoology to describe a species which name of a genus or subgenus is always bound to a specific taxonomic ranking ("International Code of Zoological Nomenclature). NHMs and NHCs contain several ‘Voucher Specimens” that are collected during biological research/fieldwork that provide concrete, physical evidence validifying the research efforts of the biologists and museum staff involved (Guardian, 2011).

Properly preserved natural history specimens coupled with accurate data offers researchers with a “physical snapshot of a species or community at a point in time and space (Guardian, 2011). Extracting DNA from a photograph or residual pesticides in organisms isn’t a practical option, let alone physically possible. So, these preserved biological specimens are needed to provide the “unexpected information” researchers need to properly conduct their studies. For example, data collected to display the detrimental effects (thinning of eggshells) of DDT on bird populations was directly derived from 19^{th}-20^{th} century DNA that was first collected, preserved and stored in a natural history collection.

Use of specimens to convey basic biological ideas

Advancing Integration of Museums into Undergraduate Programs (AIM-UP!) is a Research Coordination Network funded by the National Science Foundation (NSF). Designed to explore the potential uses of NHCs for undergraduate students studying biology. Evolutionary theory and genetic variability go together with NHCs Increased use of genetic data sets often results in problems repeating, validating and using the large influx of genetic data. Voucher specimens housed in NHCs offer an important tool to recreate, improve and add onto previous data (Cook, 2014).

Classroom activities using NHCs gives students a way to connect genetic variability, environmental conditions and changes in biodiversity. Because of the increased digitization of specimen data, students are now able to cross-reference genetic data with other institutions by using databases like GenBank (Mclean, 2016). Students can use NHCs databased to better understand spatial and temporal trends in specimen data in relation to several variables.

Biodiversity data-sharing platforms have students investigate trends in biodiversity using data sets for several organisms, photographs, recorded vocalizations etc. Some concepts that students can explore related to the data set are differences between fundamental and realized niches, habitat specialization, community composition etc. Relating the data sets with several concepts, students can predict certain changes in species composition in relation to environmental change.

NHCs are being used to trace emerging pathogens and allow students to understand and address the issues pertaining to climate change and increasing levels of dangerous pathogens.

By extrapolating genetic data from certain existing specimens, researchers can use NHCs as a fountain of information as many pathogens are found directly on skin, hair, bones etc.

NHCs provide an array of educational opportunities for K-12 and undergraduate students interested in the biological sciences by providing hands-on experience with specimens and specimen data. Inquiry-based and specimen-based learning is essential for understanding the complex mechanisms of our natural world. Collections can bridge the gap between several academic disciplines and provide the platform to for separate fields to address societal/environmental issues. A lack of user-friendly electronic resources, lack of physical access to collections, lack of funding and lack of collaboration between museum scientists and science educators presents many obstacles when trying to use NHCs for educational purposes. Fortunately, improved educational modules, implementation of more user-friendly electronic resources (i.e. Google Earth) and greater incentive for educators indicates a viable set of tools that can accessed while incorporating NHCs in education. (Karen E. Powers,2014)

A college-level student's experiences in taxon-based courses (i.e. mammalogy, botany, ecology etc) can directly influence their decisions to pursue field such as systematics, natural history or evolutionary biology/ecology. (Karen E. Powers, 2014). Although these modules present an array of beneficial outcomes, this long-standing tradition persisting at many universities, the advent of molecular biology has come to dominate the crucial role that natural history specimens play. Many institutions withdrew taxon-based courses and closed their small museums in response changing attitudes and practices (N.S. Association, 2005) . This results in lost opportunities for student exposure to the complex mechanisms of Earth's biodiversity. This is especially true for students living in low-income and predominantly minority neighborhoods. The underlying problem is due to lack of time, specimens and specialized expertise necessary to perform specimen-based research/activities in classrooms. Continuous efforts to consolidate specimen data, create educational components connecting museum and museum data, and the expanding use of natural-history specimens in several disciplines highlights the urgency to incorporate specimen-based science research/education in the early childhood – late adult education (Karen E. Powers, 2014).

Collections of natural history as innovative resources for STEM education

In the past, using NHCs was limited to academic institutions privileged enough to house a collection. Several courses in organismal biology (e.g., botany, ornithology) used specimens to understand important concepts in morphology and identifying characteristic of certain taxonomic groups. Despite the importance of specimen-based education, it solely falls short of two major ways of fully using a collection to its fullest potential. First, using just one collection fails to allow cross-reference between major taxonomic lineages and cannot be used at institutions that don't have the necessary collections (Mujtaba, 2018).

Natural history collections don't start out as digital models. Centuries of specimen collection, field notes, recorded vocalizations and photographs are the foundations which revolutionary modernization of NHCs evolve within a computerized age.

Advancements in technology allow for greater accessibility to NHCs through several networked databases (i.e MaNIS, ORNIS, HerpNET, and FishNet, VertNet) and constellation of amenities and tools. This can allow for users to search information on a certain species across several museum's collections. Primary international repository for NHC information, the Global Biodiversity Information Facility contains over 440 million specimens and records. Despite the remarkable amount of specimen data available online, this represents only around 10%-20% of the natural history specimens stored globally.

NSF's Advancing Digitization of Biodiversity Collections is a federal obligation to digitally store precious specimen data that can be used for future research. Digitization is simplifying the labors involved to produce high-quality specimen data. Also, the importance of field-research must be addressed when discussing plans to improve digitized natural history collections. Improved workflows for all components of museum curation (i.e. specimen collection, data digitization and many possible consequences. Additional issues may arise with digitization relating to intellectual property rights, licensing and socio-economic trends. Past (skins and bones) vs. Present (embryos, frozen tissues, DNA samples etc.)

The importance of STEM education in the United States educational system clearly falls behind that of most other industrialized nation. Despite this issue, many organizations such as the National Science Foundation (NSF) and Partnership for Undergraduate Life Sciences Education are receiving funding to promote science education.

As times change, the biological sciences have shifted focus away from traditional taxon-based courses and emphasize molecular biology and computerized models to explain natural phenomenon. Unfortunately, these shifts in priority often results in funding being granted more towards these "modern" sciences and less given to natural history collections. Active inquiry-based learning "personalizes" and "internalizes" the material so students can take ownership of the information they've learned.

Despite the large volume of people visiting museums, those guests are "mostly seeing the top of very large iceberg", since most (90%-99%) of natural history specimens are kept in storage, often for decades or even forever lost in the dark dusty trenches of a natural science building's basement. Dr. Allyson Jackson, an associate professor of environmental studies at SUNY Purchase rediscovered hundreds of biological and natural history specimens basically shoved into the back of supply closet of an ecology classroom. Immediately, she realized the potential these long-lost artifacts can have for natural science education in the environmental studies program.   It was brought to my attention by Dr. Jackson the need for a complete "NHC makeover" to utilize these specimens in future classes and with my proposal, the university's adjacent senior living community, "Broadview" (Guardian, 2011). "Nothing will ever replace the taxonomic knowledge and training that museums provide; funding in this area should become a national priority. Otherwise, knowledge of this planet's biodiversity, and of all the potential benefits therein, will be lost" (Suarez & Tsutsui, 2004)

Integrating Museum Bioinformatics Resources and Educational Needs

Improving technologies and shifting attitudes are creating reform in the biological sciences so these advancements need to be integrated into undergraduate education. NHCs offer a model platform to assimilate revolutionary methods in biology with striking advancements in scientific technology.

There is currently a call to reform for undergraduate education. There are 3 challenges faced in present day undergraduate education. (1) Better integration of instruction in crucial ideas and data with further investigation of the scientific process. Introduce the scientific method to students, relating abstract ideas to real-life examples and for the stimulation of curiosity. NHCs give students a feeling of instant and straightforward connection to the specimen, it's environmental condition. Students learn about important concepts and definitions by physically handling specimens and engaging deeper into the scientific process. (2) Lack of emphasis on student-centered learning experiences in undergraduate biological science courses. Traditional lecture-based classes rely heavily on unoriginal exercises with predictable outcomes in a classroom setting. Museum collections can provide an avenue for educators to shift their efforts away from less-effective passive-learning to inquiry-based research using NHCs. This shift in class format can inspire students to hypothesize their own concepts and ideas derived from this student-based style of teaching. (3) "Ensure that all undergraduates have authentic opportunities to experience the processes, nature, and limits of science". NHCs address this challenge by offering students direct interaction (collection-based citizen science) with the data and brings together a wider array of biologists and museum scientists. NHCs can potentially familiarize an array of undergraduate students with real-world examples of scientific-inquiry and discovery in biology.

Place-Based Exercises Using Museum Data

Using regional specimen data can promote greater student interest by forming a deeper connection between the material and concepts.

In Florida, human development and expansion threaten Florida's precious native flora. Collections-based research activities for undergraduate students in Florida institutions.

Field > Collect specimens > Identification (using GenBank for DNA sequences)> specimen(s) placed in proper phylogenetic order > students can draw inferences > Map(s) current distribution with historical > compare with future climatic conditions > Students can create predictions. INQUIRY-based learning exposing students to key concepts in evolutionary and conservation biology Skills acquired: specimen collection. Preservation, digitization, use of complex, hypothesis testing. Analysis and interpretation of data. Instructor can coordinate with other instructors and departments and institutions. Students can interact with students from other institutions, sharing their data and possibly collaborating on a research project.

Rarely are people opposed to natural history museums, in fact surveys reveal that 42 million visitors go to museums sponsored by the DCMS (Department of Culture Media and Support) in the UK alone. This figure is significant regarding the overall proportion of people living in the UK (62 million) to those who attend these sponsored museums (42 million). This staggering figure further highlights the popularity and cultural importance that natural history museums (NHMs) and their natural history collections (NHCs) have. The statistics alone demonstrate the importance of both NHMs and NHCs in a broader public context (Guardian, 2011).

Conceptual Programs for Natural History Based Education

Research Coordination Networks (RCNs)

Funded by NSF including programs such as AIM-UP! Designed for undergraduates in biology, AIM-UP seeks to modernize and widen the important role that NHCs play in the biological sciences. Inquiry-based and specimen-based educational models using digitized specimen data and scientific software as educational tools. VertNet, GenBank, Education LifeDesk, Encyclopedia of Life, and MorphBank. NSF GK-12 Graduate STEM Fellows in K-12 Education. Smithsonian Institution's Naturalist Center contains a three step Approach with 3 elements: (1) Resources (2) Access, (3) Cognitive Skill. Introduce thought-provoking ideas with proper exhibition of material (Karen E. Powers, 2014).

Three trends in educational use of NHCs in Technology

Access is expanding specimen digitization programs and use of collections-based bioinformatics provides greater public access to digitized high-quality specimen-level data (i.e. specimen images, specimen metadata etc.) Example: *Global Biodiversity Informatics Facility*. Mounting Importance of Inquiry-Based Education and Greater Investment in Educational and Outreach Programs by University and Museum-Based Researchers is needed to deem these modules feasible (Karen E. Powers, 2014). Federal agencies such as NSF's communicating the vital impact research activities plays on a researcher's own personal success. Increased education often equates to unexpected contributions to one's own research efforts (Karen E. Powers, 2014)

Global issues such as climate change, sustainability, invasive species mitigation, food access and evolving pathogens. A Problem lies with an increasing gap between scientists and institutions that research organic diversity and the educators and students that must comprehend the complexities of biodiversity in science. These major issues can be more easily understood if reference point environmental conditions and biota are established using natural history collections. Old way (specimen-based labs, field work, training opportunities) vs. New Way (web-based educational models that utilize the growing influx of digitized specimen data in museum work to capture the attention of much wider audience (Karen E. Powers, 2014).

Natural history collections garner interest and eagerness for phenomenon of the natural world. Museums offer traditional specimen-based/field-based research connecting with brand new technology that use molecular evolution, stable-isotope ecology and developmental biology. NHCs connect space and time**.** Inquiry based research on specimens equates with creativity, “generative-thinking “Humanities combined with Art and specimen-based inquiry research can bridge future gaps in traditionally unrelated academic disciplines. All disciplines reap the benefits of closer associations. There’s a growing investment in online learning from universities and colleges. An example would be the “International Association for K-12 Online Learning” which includes advancements in computer science, virtual labs, online community, smartphone apps and online classrooms. Natural History Collections have the grand opportunity to provide easy access to digitized specimen data for use in online labs, giving students the opportunity to use “open-inquiry”, observe virtual specimens, develop research questions, international collaboration on research projects (Karen E. Powers, 2014).

Challenges facing natural history collections

In order to properly conduct research, museums must have the ability to care for their collections and provide other researchers and the public with easily accessible databases their specific data can be inputted (Guardian, 2011). Unfortunately, due to the large volume and increasing flow of data, several museums are having difficulties to submit and receive NHC data. Funding cuts and considerable budget cuts continue to hinder the maintenance, growth and perceived importance of these collections.

Natural history collections are of high importance for cultural, intrinsic, scientific, economic and environmental reasons. So, it should seem obvious the need for increased efforts to fund and highlight the importance of these collections. Losing museum collection specialists and professional staff, partners and developers further disbands the interdisciplinary progress NHCs have made. Maintaining biodiversity and environmental changes is essential for modern progress and natural history collections should receive equal attention and support from those involved in related fields (Guardian, 2011).

Key Challenges

Three major resources are needed to fully integrate scientists and science educators. Specimens and Collections: there lies a disconnect between youth and natural world. Specimens Based Electronic Resources: Advancing Digizitization of Biodiversity Collections program at NSF Encyclopedia of Life, MorphBank, Map of Life. Specimen-based electronic resources are essential to modernize NHCs and preserve the important data needed for student-based research and interpretation. Mining raw data for student-based research contains the capability of students to interpret raw data in relation to changes in regional biodiversity (e.g. species list), bird migration, invasive species control. But a problem exists due to major lack of electronic resources catering to broad age-groups and diverse academic disciplines. But, an introduction of programs such as Google Earth and related software continues to address issues with People and Human Resources. Scientists and educators often have difficulty relating to one another. K-12 educators, teachers, environmentalists and Grad/Post-Doc students equates forms professional relationships. Introducing the complexities of scientific research to students at a young age can translate into competent scientists in the future (Karen E. Powers, 2014).

Scientific advancements in the 20th century began to devalue the role of natural history collections in the biological sciences. During this time, several universities and institutions were forced to downsize or completely dispose of prized natural history collections (Suderland, 2012).

In order to "do natural history" one must focus on the modern technological innovations that characterize natural history collection studies today. Computerization and digitation of natural history collection data has resulted in "web exhibits" that demonstrates several pathways which characteristic taxa are collected, preserved, identified and analyzed from field to museum. These web exhibits were created with the intention of providing a platform for instructor to utilize the vast array of NHC specimen data in undergraduate, graduate, post-doctoral and senior-citizen education (Suderland, 2012). The life sciences are characterized by a major shift in mid-century as new disciplines (ecology, conservation and population genetics) began to emerge (Suderland, 2012). Changes in the field of biology during the 20th century are highlighted by a shift from focus on natural history to molecular biology and genetics (Suderland, 2012).

"Doing Natural History" emphasizes the research aspect of biology while serving as a scientific tool to promote and support scientific discovery in a digitized era. Public support and awareness of NHCs and their role in science, policy making, and education is crucial if natural history collections continue to garner with growing technological advancements (Suderland, 2012).

Disassembling and moving natural history collections is often a costly process and can easily cost more than keeping the collections. For many scientists, access to these collections is essential for research so removing them is equivalent to destroying the collection itself (Suderland, 2012). Thankfully, through the efforts of Dr. Allyson Jackson and SUNY Purchase's Department of Environmental Studies, this outcome was avoided and was manifested through my intensive re-categorization, identification, cleaning/preserving, organizing (by known taxonomic ranking and phylogenic attributes), interpreting, designing and displaying prized specimens discovered through the process. Incorporation of historical field notes, specimens, live organisms, global imaging system modeling, DNA/RNA sequencing is essential to research and most of the work is dependent on reliable natural history collections, such as SUNY Purchase's own.

Challenges Faced Using Specimen-Based Research in Educational Programs

A disconnect exists between scientists and educators. Little previous education in taxon-oriented courses for educators results in educators seldom possessing initiative to use specimen-based learning into their curriculum.

Combination of both results in diminishing incentive to promote educational exercises using natural history specimens. Most K-12 educators aren't located nearby major institutions designed with interactive learning in mind. Additionally, a general lack of time further limits the opportunities for educators to use NHCs in their curriculum. "Thinking outside the box" generally is not a viable concept when integrating natural history collections and specimen-based research/education (Powers, 2014). Most NHCs don't exist to cater to the educational needs of K-12 students and usually, "choice specimens" usually are too delicate or too large for public display. Continual development of user-friendly, searchable databases provides opportunity for educators to access data for use in classroom exercises. A problem exists because many databases are large and data intensive. Data overload is a common problem faced when digitizing and cataloging specimen-data. Missed opportunities for hands-on collaboration between educators, students, directors and scientists are too common. Larger institutions such as the “Field Museum” offer summer internships but student capacity is often lowered with dwindling funding and public support (Powers, 2014).

Other obstacles in the way of natural history collections

In order to properly conduct research, museums must have the ability to care for their collections and provide other researchers and the public with easily accessible databases their specific data can be inputted (Guardian, 2011). Unfortunately, due to the large volume and increasing flow of data, several museums are having difficulties to submit and receive NHC data. Funding cuts and considerable budget cuts continue to hinder the maintenance, growth and perceived importance of these collections.

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SUNY Purchase Natural History Specimen Conservation and Exhibit Development

SUNY Purchase College’s Department of Environmental Studies/Biology has accumulated hundreds of preserved biological specimens dating back nearly 60 years.

Specimens include taxidermized birds, insects, fungi, skeletal remains and other once-living organisms. This newly rediscovered collection may provide researchers a reference to connect changes in climate with regional biodiversity. The collection may provide a wide array of educational tools that can be used by both biology and ecology departments. It only seems right this long-forgotten collection of incredible specimens receives the proper care and attention it deserves. Over the course of a semester, myself and two other students were responsible for the conservation, curation and exhibition of these specimens. This report describes the process used to identify, organize, conserve and exhibit several choice specimens.

Dr. Allyson Jackson explained the need for more space and less clutter in the ecology lab. Much of the lab's equipment is outdated and no longer used. A previous ecology professor retired a few years ago, leaving behind three metal filing cabinets with some preserved but often not preserved biological specimens. The true value of this collection can only be measured by its accessibility to researchers and visibility to the public (Suarez & Tsutsui, 2004). If the specimens were to be left as is, it is certain the specimens would continue to degrade and remain unseen and unappreciated. Our collection is severely neglected and lacks both the personnel to overlook it and the ability to bring it to the attention of students and the public.

The collection is currently housed in the basement of the natural science's building, an area prone to flooding and dampness. Storage units serve as the primary defense against damage from outside forces, but these cabinets didn't provide the most ideal conditions for storage (Carter & Walker, 1999). Opening and closing of drawers along with outside construction can damage the structural integrity of some specimens. The drawers didn't contain high density foam buffers to protect against vibrational damage from the construction outside. There weren't many alternative storage systems for larger specimens such as large bones, a problem that large dustcovers would have solved (Carter & Walker, 1999).

Neither the cabinets or drawers within the cabinets were labeled to specify any relationship between cabinet/drawer and the specimens contained within. Unlabeled and mislabeled specimens were a major problem for us. There wasn't a concise method for us to identify most of the specimens nor their age and place of origin. Outsourcing experts in zoology and taxonomy to assist in proper reclassification would have been a difficult and time-consuming task. Fortunately, a small portion of the specimens did have labels and even dated photographs of the field work involved.

There were skeletal remains mixed with feathers, unidentifiable equipment parts mixed with preserved insects, etc. Having no means of determining relationships between specimen type and cabinet/drawer made it a difficult start. Sifting through the specimens revealed how truly massive this collection was. Specimens/items found include: Taxidermized birds, turtle shells, pinecones, leaf samples, dated photographs of field work, feathers, insects (suspended in liquid), fungi, etc. After a few hours of removing specimens, it became apparent many were in poor condition with several samples emitting incredibly foul odors and displaying visual signs of decay. Except for large and intact skeletal remains, all specimens deemed too foul were treated as hazardous material and safely disposed of. At least 1/3rd of specimens removed were disposed of.

Following the process of specimen removal, we visually assessed the collection and developed a method for specimen grouping. It seemed unlikely we'd focus on precise taxonomic rankings. Most specimens were unlabeled, and our biological nomenclature was clearly lacking. Using the knowledge, we had, specimens would first be placed in groups such as bones, skulls, unidentifiable skeletal fragments, fungi, plant material, birds (whole specimens, feathers and nests), aquatic/marine and miscellaneous. After separating the specimens into these categories, we further broke down these categories into subcategories. For example, once bones/skulls were grouped together we separated specimens into groups such as jaws, teeth, femurs, humerus, tibia etc. By grouping skulls together, we were able to begin ranking specimens by taxonomic rank, sometimes down to the species itself. In hindsight, this method of organizing specimens may have not been the most practical. We did not update the collection's modern phylogenic classifications which can potentially ruin the validity of future research (Snow, 2005).

One of the greatest challenges in curating natural history exhibits is balancing an aesthetically pleasing display with a safe environment for both specimens and visitors. The urge to display only the 'prettiest' specimens is understandable but it's often these specimens that require the greatest care. For example, our collection contains dozens of well-preserved taxidermized bird specimens. In fact, many students familiar with our project will agree the birds are a highlight of the collection but unfortunately were not displayed. The delicacy of each bird specimen was too great for us to risk damaging just to 'show off' to visitors. We attempted to contact a person with experience in taxidermy/ornithology but did not get a response.

It isn't just the curators handling specimens that risk damaging them but also the numerous people viewing them during an exhibition. Environmental changes due to the presence of people can potentially alter the temperature, CO_2 content and relative humidity which can all potentially be anthropologically altered (Carter & Walker, 1999). If display cases aren't properly secured, there's a risk of people accidentally moving the case and causing vibrational damage to the specimens. Our display case is located only meters from a room full of vending machines, an elevator and one of the most heavily trafficked hallways in the building. Fluctuations in human traffic may correlate with fluctuations in the stability of the surrounding environment. The inconsistent environmental conditions of the exhibit may further damage the specimens if not properly mediated. Our exhibit is located near the entrance of the natural science building which is constantly letting in cold/hot air, always altering the temperature and relative humidity of the surrounding environment. The building's air-conditioning may help balance these fluctuations but using a climate-controlled display case would be the ideal option. It's suggested to use exhibition cases designed with materials that won't damage specimens (Carter & Walker, 1999). Our display case isn't designed for the purpose of specimen conservation so potential outside damage is a risk we must take. Environmental monitoring of natural history collections is crucial for maintaining reliable storage conditions. Routine checks on environmental conditions such as air quality, relative humidity, temperature, UV radiation and pests are important for successful preservation of collections (Carter & Walker, 1999). Consistent environmental monitoring is costly and time consuming especially for a collection like ours which is rarely used.

Specimens/items found include:

- Taxidermized birds
- Turtle shells
- Pine cones
- Leaf samples
- Dated photographs of field work
- Feathers
- Insects (suspended in preserving liquid)
- Fungi
- Coral

- Small pieces of sponge

After a few hours of removing specimens, it became apparent many were in poor condition with several samples emitting incredibly foul odors and displaying visual signs of decay. Except for large and intact skeletal remains, all specimens deemed too foul were treated as hazardous material and safely disposed of. I'd say at least 1/3rd of specimens removed were tossed away. All remaining specimens were carted away and left in the wildlife ecology lab until our next step.

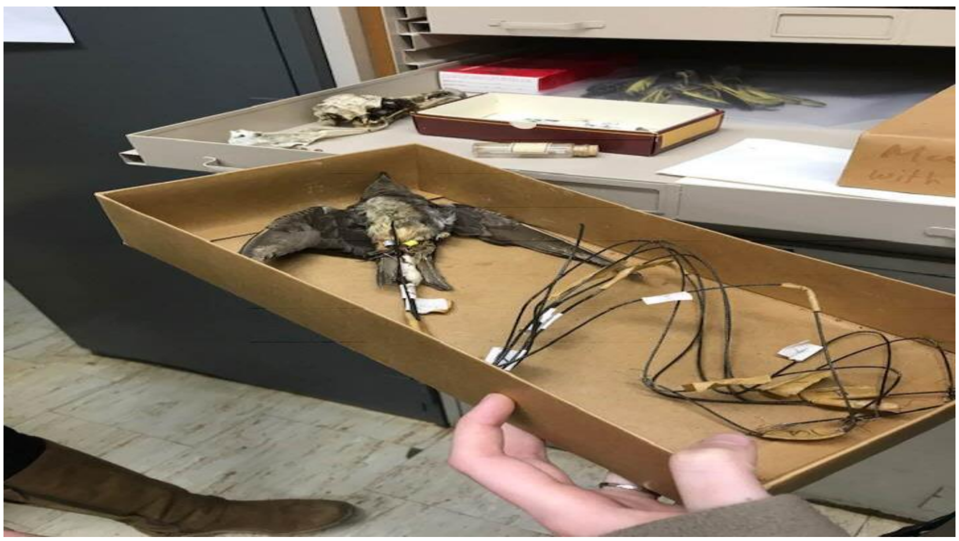

Fig 1. Photo of specimen during removal process, displaying the unorganized state of the original collection (deer skull, bird feathers and lab equipment all in the same drawer)

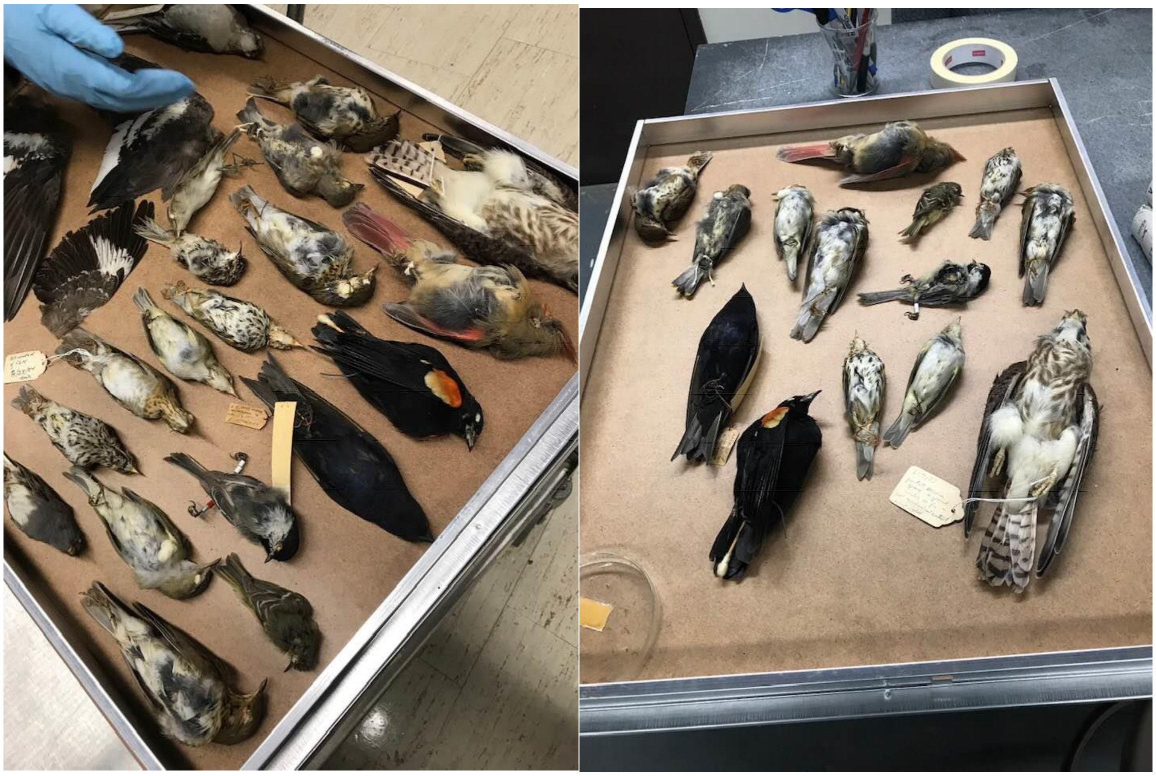

Fig 2. Photo of taxidermized birds found in cabinets.

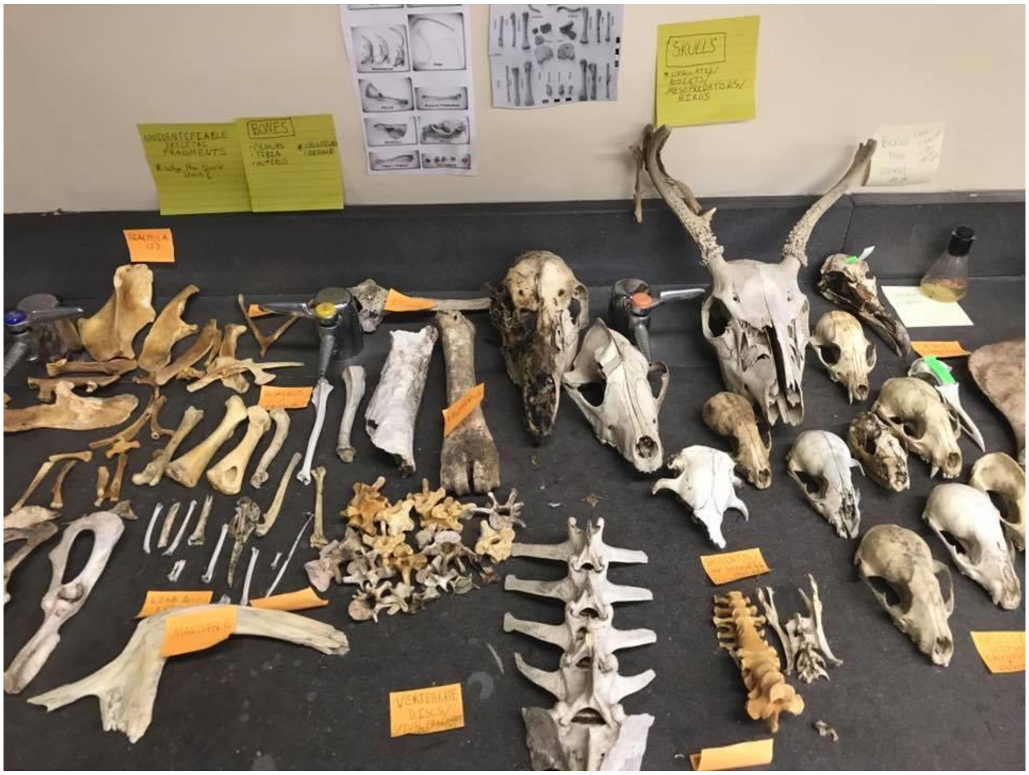

Fig 3. Skeletal remains divided into subgroups

After categorizing specimens into their respective groups, we then began the process of carefully choosing which specimens were appropriate for our exhibit. Ideally the display would contain visually appealing specimens arranged in a way that educate the general public about regional biodiversity throughout time on SUNY Purchase College's campus. The exhibit development is not priority at this point for more work needs to be done. Skeletal remains deemed useful for our intentions were now planned to be clean and conserved.

To ensure the longevity of choice bone specimens, a proper cleaning was necessary before display/placing back in collection cabinets. This is the process used to ensure bone specimens were not only visually appealing but also safe for the public.

1. Using proper sanitation procedures (i.e. wash hands/wear gloves) we began the intensive work involved with processing and cleaning bones. This procedure was not only tedious and time

consuming but generally just disgusting. Remaining hide, hair, dirt and unknown substances were picked away by hand to remove large pieces from specimens. Warm water and a hard-bristled toothbrush were used to scrub away remaining non-skeletal material from deep crevasses in the specimens. Once bones were absent of any visible non-skeletal material, we placed them in large glass vessels with warm water and Dawn dish soap (1:10) letting the bones soak for over a week. After a week we revisit the glass vessels and find the bones sitting in a hellishly putrid decomposing liquid emitting the most awful smell I've ever experienced. The previously clean soapy water has now liberated the remaining fleshy material, which now sits atop an inch-thick layer of bubbling foam. The bones were removed from the death stew and immediately rinsed under warm water. Thankfully, the meticulous work of cleaning these bones paid off as the specimens were much cleaner, less foul smelling and somewhat brighter than before.

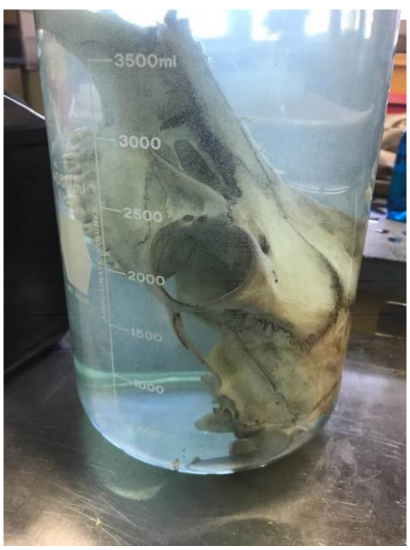

Fig 4. Skull soap/water solution.

After all bone specimens have been cleaned and sorted began the process of exhibit development. SUNY Purchase's new media department granted us a display case to exhibit choice specimens found in the process of cleaning the ecology lab. The most aesthetically pleasing specimens were artfully placed in the display case to catch the attention of people walking by and hopefully garner public interest in regional ecology. Unfortunately, the taxidermized birds were not displayed due to delicacy of specimens and lack of knowledge about how to properly display them. Descriptions about each item were written and displayed with corresponding specimens.

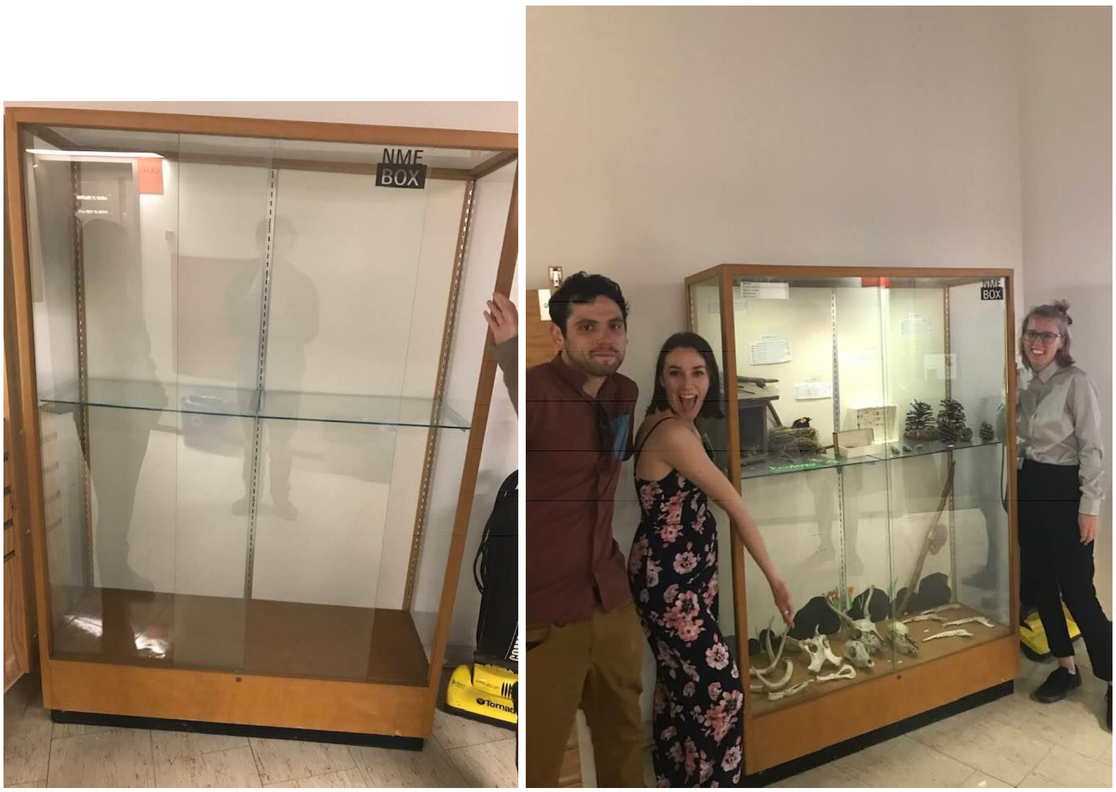

Fig 5. Display case before and after

Each drawer of every cabinet was labeled with corresponding specimen categories used when categorizing in the wildlife lab. Any specimens too large to fit in the cabinets were covered with cloth and left in the wildlife ecology room. Specimens were neatly placed in their new labeled drawers for future research. Lastly, we made sure all surfaces were clean of all organic material and properly sanitized.

Proper illumination of the exhibit is necessary to draw the attention of people to it. The display case has an adequate built-in overhead lighting system but is seldom used. A time-switch on the internal lights can potentially provide the opportunity for a consistent schedule of illumination. Constant lighting or light bulbs of a high wattage can damage the structural integrity of the specimens being displayed (Carter & Walker, 1999). The display case is currently located in an area with little to no natural lighting. If it can be moved to an area with greater natural sunlight, the internal lightbulbs may be unnecessary.

Students and faculty have access to an incredible array of preserved biological specimens. This natural history collection may provide insight about the effects of environmental change on regional biodiversity and ecosystem health. Proper handling and care are necessary if specimens are to be used for future research and enjoyment. Unfortunately, the display case fell over a few days ago, destroying the entire exhibit and damaging its contents. This event reflects the risk curators undergo while displaying their prized specimens and highlights the need for improved curation practices. Greater effort must be made by students, faculty and the public to preserve collections owned by SUNY Purchase if it is to be cherished for future generations.

Adult-Learning Through Natural History Museums

The need for greater connectivity between generations and vulnerable groups in communities to achieve their mutual benefit is fundamental. However, how best to enable this connection is less well-known, particularly where there are multiple issues for communities. Thus, the ILAS is particularly interested in how populations can be connected through participatory approaches to *improve the chances of more meaningful intergenerational cohesion. In particular, the Institute wishes to learn more about how resilience of capacity to overcome adversity through social support can be enabled between children, youth, adults and elders, and in the context of disability." – Thomas Scharf*

Many assume that aging is defined by an "involution", a stoppage to the advancement of education the elderly. We often perceive elderly people as unable to learn new things and collaborate with the general public. Several theories such as activity theory and continuity theory show that increased activity in later life results in increase cognition, personal development and usefulness to society (Bodi, 2018). There is currently a shift in preconceived notions of aging and a social change in attitude towards the overall capabilities of continuing education among seniors. A more "open cultural approach" should be implemented at Broadview between residents and students as the concept of "successful aging" becomes more prominent (Scharf, 2016)

An example of a program that addresses issues pertaining to senior inactivity, the "Senior Academy" serves as a feasible template that can be used by other universities such as SUNY Purchase which integrate adjacent (often unrelated) senior assisted living communities (ALCs) with undergraduate programs and other facets of the college environment (Bodi, 2018).

"Senior Academy" began as a conceptual project intent on providing several diverse activities coupled with social integration with both the resident's living community and its respective university/institution. The program was a direct response to the current elderly population's desire to learn and acquire new skill sets that can be used in the community (Bodi, 2018).

Newly developing programs for seniors integrated into universities promotes the use of modern technology as tools for easing a generational technological disparity while contributing to elderly quality of life (Bodi, 2018). Out of all courses provided by the "Senior Academy", digital technology courses were the most popular among senior residents. Students were encouraged to interact with the senior residents by educating older populations on using modern technology such as smartphones, tablets and online databases (Bodi, 2018). These findings can easily be incorporated in the mission of Broadview especially regarding seniors identifying, collecting and interpreting the natural history collection at SUNY Purchase College. Elderly requirements are taken into consideration during the development of the "Senior Academy". Some examples of these requirements include but are not limited to increasing the visibility of the elderly community, preventing crimes against the elderly, promoting a healthy lifestyle, promoting the concept of active aging and changing social attitudes to encourage seniors to use modern technology to improve their quality of life (Bodi, 2018). Many elderly people who maintain an active lifestyle (mentally and physically) tend to have better management skills when dealing with aging optimally (Bodi, 2018).

Activity theory highlights the many positive aspects of aging and relative activities post-retirement and suggests that higher activity results in higher levels of meaningfulness, use to the community/university and overall better quality of life (Bodi, 2018). Continuity in activity and individual personality can benefit the process of "successful aging" or positive ways in which older people can have a meaningful experience later in life (55+) (Boulton-Lewis, G.M.)

To progress the dialogue about integrating senior living communities with a younger group of people (university undergraduate students) we must rethink the very relationship between these differing generations (Bodi, 2018). An increasing global population doesn't exactly mean less people are dying but rather that more people are living to an older age. Research statistics reveal that the percentage of people past 60 years old will exceed the present 21% and grow to 33% by 2030 (Bodi, 2018). There is a need for change in the way people perceive how meaning in life is changing with current trends in population dynamics (Bodi, 2018). Recently, many developing universities and collegiate institutions are integrating campus space with elderly education. The concept of "Intergenerational Contact Zones (ICZs)" addresses the potential benefits both universities and senior assisted living communities may gain by collaborating on research, education and service missions of universities (Scharf, 2016).

For example, the Institute for Lifecourse and Society building at the National University of Ireland Galaway (ILAS) contains multiple research centers. A focus of this institute is to highlight several aspects of the life course through research, education and policy and practice development (Scharf, 2016)

Intergenerational Contact Zones

Despite the concept's revolutionary image, the idea of intergenerational contact isn't new. In fact, the function of universities has always been one of intergenerational collaboration. Older professors and school faculty are constantly interacting/benefiting from one another's generational strengths and weaknesses (Scharf, 2016).

In order to put these ICZs into practice, we must address three challenges that universities have with traditional university models. Demographic change such as decreased fertility, longer life expectancies and higher volumes of people attending/teaching at universities. De-institutionalization of the life course (i.e. reevaluating the concept of higher education in respects to certain individual's (specifically older generations) and current life trajectories. Thirdly, incentives for universities to better contribute to local communities are some examples of these challenges (Scharf, 2016).

"The Irish Centre for Social Gerontology" has recently been supporting several intergenerational activities by offering workshops on issues pertaining to intergenerational education and initiating a doctoral program on programs that involve intergenerational education (Scharf, 2016). Another example, "The Community Knowledge Initiative", is a program that creates relationships between communities and universities. Student volunteers within the program help senior-citizens tackle issues involving senior-based activities, especially by training older adults to properly use IT software and the relevant software (Scharf, 2016). ILAS facilities have been attracting research in intergenerational issues which increases a university's capacity for catering to multi-generational groups thereby diversifying an institution's age-profile (Scharf, 2016).

Several approaches have been taken to encourage the involvement of older generations in a university's programs/curriculum. Traditionally, many universities with ICZs are separate from their surrounding senior-living communities. Currently, other schools such as SUNY Purchase are encouraging the collaboration between "traditional" students at universities and residents of senior-living communities who inspire to learn more and contribute on several different levels. The increase in intergenerational relationships between "traditional" students and senior citizens poses the question, "What are some effective ways to transform 'multi-generational' classrooms into intergenerational classrooms?" To address this issue, the ILAS facility has allotted several classroom spaces to be transformed into a type of "classroom laboratory" used to discover new ways to maintain and increase the involvement of older-adults into "age-integrated learning experiences" (Scharf, 2016).

A handful of ILAS faculty were chosen to research the four dimensions of anticipated benefit. These dimensions include "impact on individual learners", "impact on participating educators"; 'impact on university", and "impact beyond the University". Despite the many positive aspects of intergenerational programs, several complications arise that may hamper the progress of ILAS and ICZs. For example, the simple fact that these intergenerational programs aren't yet determined to be a priority for university missions. Or, at least not yet. Also, ICZs are known for being reputable sources for research quality and customs that involve public policy and professional practice (Scharf, 2016). Challenges faced by ILAS and ICZs aren't complete blockages to the development of these intergenerational programs. The benefits far outweigh the risks, so we must address these challenges to validify the obvious benefits these ICZs have on universities, older-learners and the public (Sharf, 2016).

Broadview Retirement Community

Fig 4. Conceptual Digital Map of the developing 'Broadview Senior Living' facility on SUNY Purchase College Campus

At the corner of Lincoln Avenue and the West Loop, behind the Administration Building, an innovative living and learning community for people 62 and older, called Broadview, will be built on 40 acres. There will be two, four-story residence buildings that will hold 174 apartments and 46 villas. Twenty percent of the units at Broadview will be affordable and made available to low- or moderate-income seniors. A shared space at Broadview called the Learning Commons will be open to everyone–students, faculty, and staff as well as Broadview residents—and will feature a café, computing lab, classrooms, maker and performance spaces, and more. There will be two residential buildings on four floors that will hold 174 apartments and 46 villas. Twenty percent of Broadview's units will be affordable and made available to seniors with low or moderate incomes. A shared space at Broadview called the Learning Commons will be open to all students, faculty and staff as well as residents of Broadview. Students will also be open to the classes and courses offered to Broadview residents at the Learning Commons. There will be job opportunities for students, faculty and staff. It is most likely that construction will begin in 2021 and finish in 2022, when the first residents arrive. A non-profit, 501c3 called Purchase Senior Living Community Inc., no college money is being diverted to this project (SUNY Purchase College).

Institutes such as the ILAS and Broadview can be used as an "intergenerational research and teaching hubs" which can potentially offer the University with an increased revenue stream and improved educational methods on campus, in the local community and online. These possible results of such institutions can improve educational/living quality for both traditional and non-traditional learners (Scharf, 2016).

Proposal

My experience curating SUNY Purchase's long lost natural history collection and extensive research on adult-learning in university associated senior-assisted living communities has provided me with the tools to conceptualize a program that integrates both SUNY Purchase College's undergraduate student body and faculty with residents of the developing 'Broadview' assisted living community.

Senior citizens have a strong desire to continually learn throughout their older years. An apparent generational gap is hindering this collaboration as each group's set of values are based on generational customs, experience with older age and differences in what brings fulfillment in life, physical/mental limitations and working knowledge of modern technology. It was my aim to bridge this generational gap through the development of a conceptual program(s) that joins both groups in a collaborative effort to benefit SUNY Purchase College, Broadview and the local community.

Developing a collaborative program between Broadview and SUNY Purchase College (specifically using SUNY Purchase College's natural history collection) can't begin without outlining markers of success. One indication that can evaluate the success of my concept program would be based on an online survey (pending how well undergraduate students are able to teach modern technology to senior residents) that asks all residents if they participated in any collaborative programs between SUNY Purchase and Broadview. If respondents answer 'yes' as a majority of replies I'd further ask which programs they prefer (i.e. field specimen collection vs. computer coding) and whether they chose one program category due to physical/mental limitations, desire to 'keep up' with the modern world, desire to contribute to society etc.

Hopefully, enough residents respond to analyze/interpret data and conclude the results are either significant or non-significant.

My specific program entails the use of the natural history collection and several prized, aesthetically pleasing and easy to handle specimens. Specimens such as skulls, bones, shells, furs, taxidermized birds/mammals would satisfy both safety for residents involved, ease of transport from the natural science building to Broadview, enough familiarity with at least some specimens and intriguing enough to grab and maintain the attention of senior residents.

Much like my experience in the natural history curation process, residents would be involved in field collection, identification, cleaning/preserving, cataloging (specifically into online databases such as 'VertBank' or 'MorphTree', interpreting trends between their findings, undergraduate findings and cross-referencing trends between institutions to compare and analyze variations in biodiversity with respects to urbanization and climate change. Once the curation process is near-complete, Broadview residents would be asked to conceptualize, develop and implement their own natural history collection exhibit or for lack of a better term, "Broadview Museum of Natural Science". To be fair, this proposed exhibit/museum would be continually rotating between groups of residents involved in the project. Environmental Studies students would also have the option of working with Broadview residents. Students have the ability to educate senior-residents about their own experiences with the natural history collection, what it "means" to them and how these specimens and respective exhibits can be utilized for involvement with local community members, low-income minority schools in the surrounding region and other museums and institutions. The potential benefits from this program are wonderful as two generational groups from different cultural backgrounds, life-experiences, socio-economic backgrounds and educational backgrounds all work together to better understand the “story” behind both long-forgotten and newly discovered natural history specimens. Senior residents at Broadview can learn from younger students about modern affairs (technology, advancements in science/education, culture etc.) while younger undergraduate students gain satisfaction for helping the elderly, who often don’t interact with younger people, or people for that matter.

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