Purdue University
Purdue e-Pubs

Proceedings of the IATUL Conferences | 2012 IATUL Proceedings

Creating a Materials Samples Collection to Support the Engineering Curriculum

Dee Magnoni
Olin College of Engineering, dianna.magnoni@olin.edu

Ananya Kejriwal
Olin College of Engineering, ananya.kejriwal@students.olin.edu

Charles Offenbacher
Olin College of Engineering, charles.offenbacher@students.olin.edu

Dee Magnoni, Ananya Kejriwal, and Charles Offenbacher, "Creating a Materials Samples Collection to Support the Engineering Curriculum." *Proceedings of the IATUL Conferences.* Paper 25.
http://docs.lib.purdue.edu/iatul/2012/papers/25

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.

CREATING A MATERIALS SAMPLES COLLECTION TO SUPPORT THE ENGINEERING CURRICULUM

Dee Magnoni, Ananya Kejriwal, Charles Offenbacher

Olin College of Engineering, United States

dianna.magnoni@olin.edu, ananya.kejriwal@students.olin.edu,
charles.offenbacher@students.olin.edu

Abstract

Engineers fundamentally solve problems. Engineering students are obtaining the education necessary to develop problem-solving skills and tools. Olin College of Engineering was founded on the philosophy that a hands-on, entrepreneurial, design-centered engineering education would create engineers ready to solve current and emerging problems.

Olin's library has embraced the college's philosophy through the development of a realia, or learning objects collection that supports multiple intelligences. Moving beyond these learning objects, library staff wanted to build a collection of materials samples that enhance the engineering curriculum, and specifically design, sustainability and materials science courses. Students use the objects to make project decisions and for inspiration. The hands-on nature of the collection aligns with the pedagogical philosophy of the college. These objects are physically available and also are beginning to have digital representation. A growing partnership between the library and specific courses is helping build the collection, while subscriptions from vendors assure a steady growth of new objects.

The collection requires three phases of thought and development beyond acquisitions: display of objects, storage of objects, and the digital representation of objects. The digital representation has several layers of development, from database building to metadata decisions to object photos to the workflow & policy decisions.

This paper will briefly discuss the philosophy and development of Olin College and the Olin College Library, and then address the evolving materials collection. The collection creation was informed by site visits to other types of samples collections such as museums and curriculum centers, discussions with faculty, partnerships with vendors, and re-alignment of existing library collections and space. The physical and virtual collections are beginning to directly serve student and curriculum needs, provide a sense of collection ownership by the contributing students, and create new partnerships with faculty.

Keywords

materials samples; design; display; storage; digital representation; database development; curriculum support; library partnerships; engineering education

About Olin

In the late 1980's the National Science Foundation and the United States engineering community discussed the need for more entrepreneurship and creativity along with social, political and economic context in engineering education. The Franklin W. Olin Foundation, who had been funding buildings on college campuses for more than sixty years, responded to this call by making the decision to build a new engineering school. The Franklin W. Olin College of Engineering received its charter from the state of Massachusetts in 1997 and the college's leadership team was hired by the end of 1999. The college officially opened its doors in the fall of 2002 with the arrival of its first freshman class. The school is small, with approximately 350 students, 35 faculty members and 3 librarians. The curriculum is specifically hands-on, entrepreneurial and design-centered with underlying ties with the arts, humanities and social sciences.

An Overview of the Materials Samples Collection

During 2003, Magnoni began working with two faculty members, Dr. Jonathan Stolk and Dr. Benjamin Linder, to outline a materials samples collection. The original concept was to have students and library staff contact manufacturers and request specific material samples. The samples would be barcoded and tagged, then organized in a set of cabinets that would be located in both the Library and the Academic Center. Cabinets were purchased and manufacturing catalogs ordered, but the school was still young and basic collection & services building activities took precedence over the samples collection.

Figure 1 Original samples cabinets and current open storage

Parallel to this process, the library became aware of DesignAid, a materials samples product emerging from Inventables. The library became an early customer to DesignAid, and was able to build a collection with minimum staff labor. These early samples were successful for inspiration in student project work. The samples have a database component that provides material properties and product ideas. Fast forward to 2008, the year that the economy shifted downward. The library needed to find an alternative vendor to supply samples. There was not yet staff to devote time to the collection, and a vendor solution was still the optimum solution. Materials Connexion was identified and the collection continued to grow with these alternative samples.

While the growing collection served an inspiration and innovation purpose, the samples did not specifically fit into the curriculum or specific courses at this point. Work with the initial faculty members subsided in this area for several years.

While the samples collection quietly grew, the topic of sustainability gained increasing importance at Olin College. The school is close to Babson and Wellesley Colleges. Babson specializes in business education and Wellesley supplies a quality undergraduate education to women across the arts, humanities, social sciences and sciences. The three schools, with their complimentary curriculums and close proximity, have begun to cooperate on a number of levels. The most ambitious plan to date is a joint Sustainability Certificate Program that was launched for the fall 2011 semester. Students from the three colleges can apply to the program, and courses are taken at all three schools.

This new program dovetailed well with a 2010 grant Olin's library received to develop sustainability collections and programming at the college. In addition to traditional library resources, Magnoni identified a vendor in Rhode Island specializing in sustainable material samples. Using part of the grant funds, Magnoni purchased an initial supply of Ecolect samples (http://ecolect.net/). These samples will now continue to grow, and directly support both the Sustainability Certificate Program and other courses at Olin.

Figure 2 A sample from Ecolect and a metal sample collected from student project work

The grant also supplied support for returning to the initial mission of the collection with stronger ties with faculty members and the curriculum. Once again original samples from manufacturers would become part of the collection development process. This time, rather than relying on library staff, ties would be created with design and materials science courses at Olin that work with original samples during the course of the semester. Students in these courses would be required to donate a sample of the material that was used during the semester, and include metadata that would aid in classifying and storing the sample. Metadata would range from manufacturer to material components to properties, along with reference back to the course where the sample was used. Library staff and faculty members are in the design phase of this approach, and the initiative will launch in the fall 2012 semester.

With renewed focus on the growth of the collection, a more formal arrangement for maintaining the samples became important. Display, storage and digital representation of the collection needed to be explored. While materials samples collections are not common in engineering libraries, they can frequently be found in design libraries, museums, architecture firms and educational resource centers. Through the grant Magnoni was able to make several site visits. The original purpose of site visits was to evaluate the display of objects and to note the circulation system in use. The evaluation of sample storage quickly became another important component to each visit.

The digital representation of the samples involves the selection of database software, design of an interface and metadata elements, creation of object images through a photo project and finally a potential circulation component. Display, storage and digital representation would all need policy and workflow documentation. While the framework of the collection was put in place along with initial policies and workflow in the summer and fall of 2011, the digital representation of objects was begun in the spring of 2012.

The library pulled its existing materials samples that were purchased over time together with the sustainable materials samples to create an accessible samples collection that could be used for sustainability, materials science and design courses as well as for individual and group projects. The pooling of the samples required an adjustment in library space. A large shifting process was done in parallel with a minor weeding process. Two rows of shelving for open samples storage were created. Additionally, journal shelving that was no longer in use was converted to space for the display of samples. The plan is to have photos of each sample on the outside of the shelving. The actual sample can be accessed by lifting the shelving.

Site Visits to Existing Samples Collections

Each site visit provided valuable best practices, lessons learned, and general advice from staff. Key summaries of Magnoni's visits are provided here.

Rhode Island School of Design (RISD): RISD began collecting material samples through collaboration with a design course on campus. Students would request samples, and the library worked through a project to define important metadata fields. The student sample collecting included obtaining the metadata information for the library. Display of the samples was its early stages, with shelving in a public space set aside for the project. Key take-aways were the involvement of library staff with the design course students and faculty members in the development of the samples collection and the discovery of a new materials samples Special Interest Group in ARLIS/NA, the Art Libraries Society of North America (http://www.arlisna.org/).

New England Aquarium's Teacher Resource Center: The New England Aquarium supplies lesson materials, media, and physical kits to teachers in Massachusetts and in the United States. The kits each have inventories attached to their inside cover, and tags on the outside clearly label the kit name and purpose. Sometimes a grade range is included. There are also containers of objects that could be borrowed. A key lesson learned was that everyday materials could be used for storage, and that an extensive budget is not always necessary. For example, plastic salad containers were used to store many of the objects. The space was also organized by broad themes rather than a narrow classification system. A series of colored circles was used to distinguish themes.

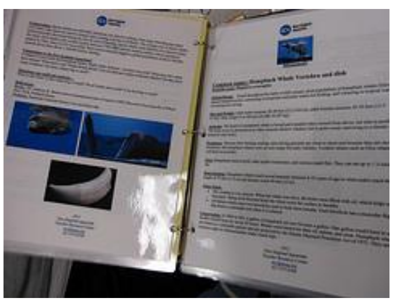


Figure 3 New England Aquarium's Teacher Resource Center, Boston, MA, USA

Massachusetts Institute of Technology Museum: This visit underscored the depth of each of the elements of an objects collection. Careful work has been done over many years to develop policies, workflow and products around the display, storage, and digital representation of objects.

Older, physical records have been kept of early collections. Floor plans of storage cabinets and shelves exist that provide a map of object storage numbers. The importance of processing guidelines was discussed, as well as metadata fields. In addition to having inventories of objects within boxes, there are also check-in and check-out logs kept in storage locations. The *MIT Museum Collections Manual* (Whitlow, J., 2008) is available online. A book, *Museum Registration Methods 5th Edition* (Buck, 2010), was recommended by both the MIT Museum staff and by the Beneski Museum staff as a useful guide to thinking through object collections.

Figure 4 MIT Museum, Cambridge, MA, USA

Harvard Graduate School of Design's Frances Loeb Library: The materials samples collection at this library most closely reflects what Olin is building. The samples have been collected by students over time, and the types of samples are largely driven by student interest. There is a display element to the samples and a storage element, though the stored samples are viewable in the same room. Samples are organized around material type. Data elements were discussed for the digital records. There is currently no circulation of the samples, though this is under consideration. The room that holds the collection has a classroom, and design classes are brought into the space and samples are retrieved in advance for class use. The duel display/storage of samples in the same room along with the use of journal containers for samples storage were key take-aways from this visit.

Figure 5 Harvard Graduate School of Design's Frances Loeb Library, Cambridge, MA, USA

Khun Riddle Architects: When Magnoni initially considered a materials samples collection, she envisioned a collection similar to an architecture firm. Offices frequently have extensive collections of tiles, flooring, paint samples and more. Khun Riddle was chosen for its interior design collection and its focus on sustainable building. Because architecture firms use products in their projects, companies send samples in hopes that those materials will be used in future projects. Trade shows were identified as great places to find new companies and materials. The display and storage of materials is one and the same, here. There is no circulation policy. Architects simply borrow what they needed and then return the samples.

Figure 6 Khun Riddle Architects, Amherst, MA, USA

Natural History Collections at UMass Amherst: The natural history collection at UMass Amherst is made up of preserved animals, fish, birds and the like. Many are preserved in fluids, and many others are stuffed. The collection grew over time in individual faculty offices. Only in the past few years were collections brought together. In the past few months a new space was opened and the specimens were moved onto shelves or into cabinets. Specimens were categorized by general groups. The collection is almost entirely a teaching collection, which provides a different approach to circulation and database concerns. Part of the object call number includes the assigned general group of the object. Practical shelving lessons as well as the labeling of different types of specimens were the key take-aways from this visit.

Figure 7 Natural History Collections at UMass Amherst, Amherst, MA, USA

Beneski Museum of Natural History, Amherst College: This museum is a place of beauty and a showcase in educational display of objects. One of the first and most practical pieces of advice that Magnoni received was to create a guide of where everything pertaining to the collection is located and then to share that guide with others on campus. Physical display of objects with archival foam and the creation of nested foam through a whittling process were showcased. Not all objects need archival materials for storage, and storage/preservation pricing and object importance were considered. Metadata fields were discussed, as well as the storage of object photos. The importance of software support from the Information Technology department was emphasized. Physically labeling some samples directly was explained. Finally, the New England Museum Association (NEMA) was recommended as a local resource (http://www.nemanet.org/).

Figure 8 Beneski Museum of Natural History, Amherst College, Amherst, MA, USA

Student classification work

Magnoni hired two student workers in January 2012 to focus on the classification and organization of samples. Ananya Kejriwal was hired as a materials student to focus on classification. Charles Offenbacher was hired to create the samples database. The spring 2012 semester included two parts: determining a classification system for the materials collection and then starting the categorization and sorting of existing samples.

To determine a classification system, Kejriwal researched materials collection databases at companies and other libraries, and interviewed various members of the Olin community to determine the unique design goals for Olin. Inventables and Materials ConneXion were the two companies researched, and both have samples represented in Olin's library. The database at Harvard University's Graduate School of Design closely follows the Materials ConneXion categories and includes information on composition, form, process and properties. The "Materials Lab" online database at the University of Texas School of Architecture influenced Olin's organizational design most strongly. The database has five main categories: composition, form, process, properties and applications. There is a balance between search and discovery capabilities, enabling students to search for materials by name or properties, or to discover materials by looking through available tags. Other libraries with known samples collections such as the Rhode Island School of Design were included in background research.

Turning to the Olin community, Kejriwal first interviewed Dr. Deborah Chachra, a materials scientist. The conversation included a discussion on identifying the core purpose of the collection and deciding critical qualities of the database. Discussing purpose, many questions were asked. What are Olin students looking for? In what ways can the collection be useful to Olin projects? Do students already have some idea of what they're looking for, and need samples to confirm the properties? Are they unsure of what material fits their needs? Or are they unaware of the base material property needs? Are the materials best used for random discovery? Upon answering these questions, the classification system could be built around identified needs.

Kejriwal went on to conduct student interviews aimed at answering some of the questions posed in the Chachra conversation and to identify the goals of Olin's collection.

In terms of a database, an online component would be essential for student use. Students need to be able to search the database with key words or properties such as *Sustainable* or *food-safe*. Student-driven and modifiable tags and search terms were emphasized. Having a selection of tags created by project staff would give students a sense of what level of detail would be useful in the database. For example, use *foam* rather than *cellular solid*. A pointer to a datasheet or more information about the material would be helpful.

Student interview feedback included:

> "I play with the samples when I want a break from work"
>
> While there were many people who currently don't use the collection at all, the ones who did usually visited the collection just to play and have fun with the samples. This may be partially due to the current organizational system which doesn't allow for a systematic search of a database, or could mean that students weren't yet identifying the collection as a reference.
>
> "Some samples are really cool. Where can I get more information or order them?"
>
> In order to be useful, more information needs to be available on the samples. How is the material made? What are its common uses? Where can it be acquired? Materials that are included in the materials science education software CES EduPak (http://www.grantadesign.com/education/) could be linked to samples in the Olin database, enabling students to get detailed information easily and compare to alternatives.
>
> "Current collection is cool but not useable"
>
> To make the collection more useful to student projects, acquiring a basic collection of regularly used materials is critical. Certain basic samples such as Teflon and blue foam are needed. Samples from McMaster-Carr, a materials provider, could be useful so students could see materials before ordering them for their projects, and also become familiar with possible alternatives. For example, when teams are choosing between ½ inch and ¼ inch base aluminium, they can currently look at datasheets. Playing with a physical object to see if it will bend or not provides greater material context.
>
> "I would like to be able to actually test the samples"
>
> Many students expressed interest in destructive testing of the samples to understand them better. They proposed having additional samples available for student projects. While making samples available for destruction is not immediately practical, methods for rapid acquisition of duplicate samples by students could be explored.
>
> "Remind more people that collection exists"
>
> Students like the collection but often forget about it. Linking samples use to classes like *Introduction to Materials Science*, *Mechanics of Solids and Structures* and *Design for Manufacturing* will be helpful. Making the collection more visible will increase student awareness. One possible idea is to feature six materials a week on the top floor.
>
> "Host a Materials Hackathon"
>
> A design challenge may be an effective way to get students interested in and inspired by the materials collection. A few cool materials could be ordered in bulk and have an activity planned around them.

In parallel to the community interviews, the decision was made to focus spring semester work on the creation of the online database and the classification of materials rather than the physical arrangement of samples in the collection. The online database will be accessible to the community and will include searchable tags and properties. Once the digital infrastructure is in place, the physical organization will easily follow.

When the work on digitally representing each sample began, a goal was to work broadly with many samples rather than deeply with a small set. This meant that initial tags and descriptions would be assigned, but photographs, links, data sheets and the like would be added later. The chosen major categories were: composition, properties, form, applications and manufacturer information. These categories were chosen because they seemed relevant to how students would search for materials for projects or information. The other category that would have been useful was manufacturing process but this was dropped because each sample would require process research. This category can be added to records in the future. All the categories were built as tagged terms so the materials could be easily searched and compared. Additionally, tagging allowed for more consistency in documentation. An additional description text box was added to encompass more information on the sample. Again, this text was built to be searchable.

Working through the collection, Kejriwal identified several start-up weaknesses of the early digitized collection.

1. Sample information is not consistent. Details vary from sample to sample, especially between vendor types.
2. There is no detailed materials information about any given sample. The database currently has very high level descriptions. Details are hard to find because the information is often patented or considered proprietary technology, and therefore not publically available.
3. Categorization is very time-consuming.
4. The applications category is not thorough. Only prelisted applications from vendors have been added to the database although the same sample can be used in many different ways. This is a conscious decision because of the time tradeoff.

While Kejriwal will be graduating, next steps for a new student worker include:

1. Continue to categorize materials and build the online database.
2. Take pictures of samples.
3. Acquire student project samples.
4. Start physical categorization. The recommendation is to do categorize by composition.
5. Raise awareness of collection on campus.
6. Working with Library Director and Faculty members, Integrate collection into various classes.

Database Development for Digital Representation

Olin's online database was modelled after the University of Texas School of Architecture's Materials Lab site (http://www.soa.utexas.edu/matlab/search/). The database has a homepage organized by top-level categories and a cookie-crumb navigation system to browse through subcategories. When the user has found the desired material, information is displayed on a page that automatically includes any pictures and metadata about the material. Available metadata varies between materials, so the site was designed to be flexible in including all information about an item.

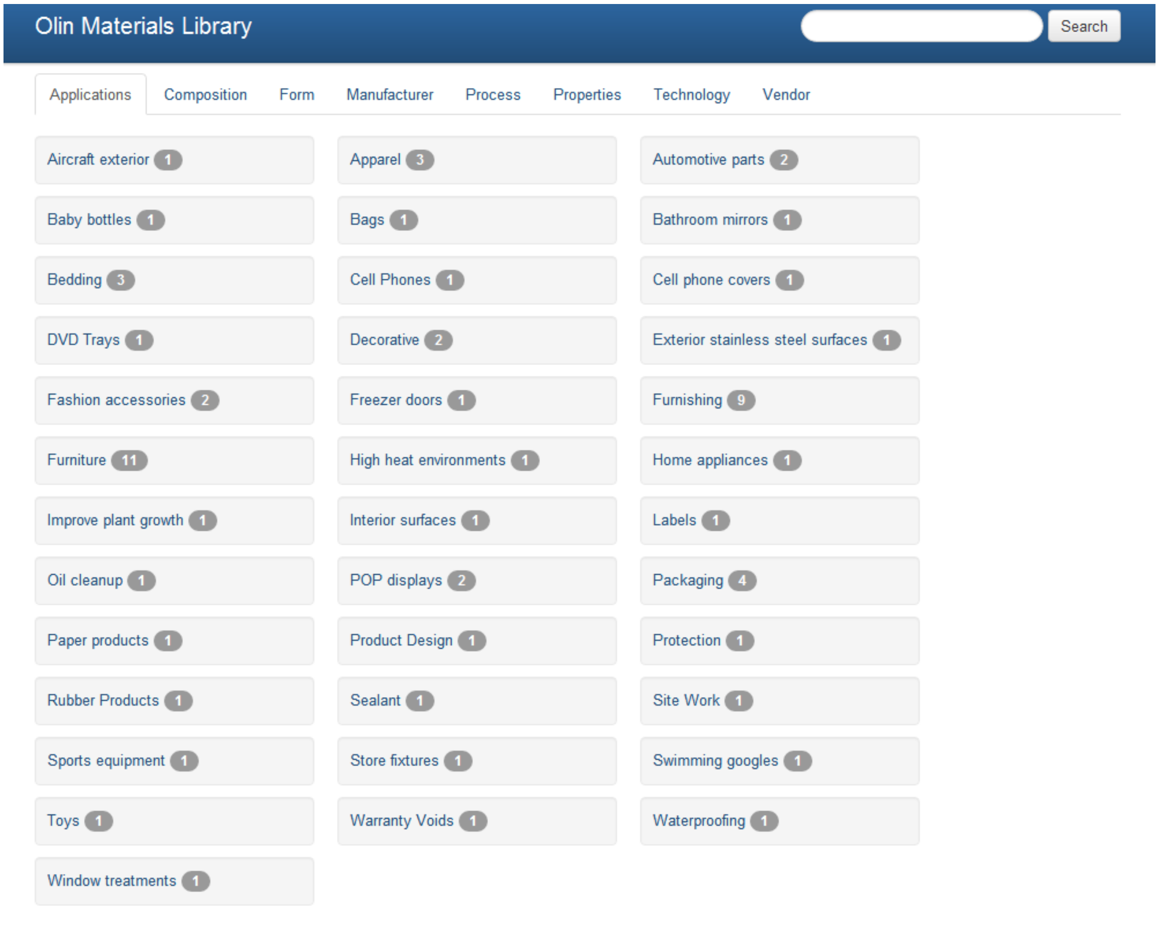

Figure 9 Olin's Materials Samples Database, Top Level

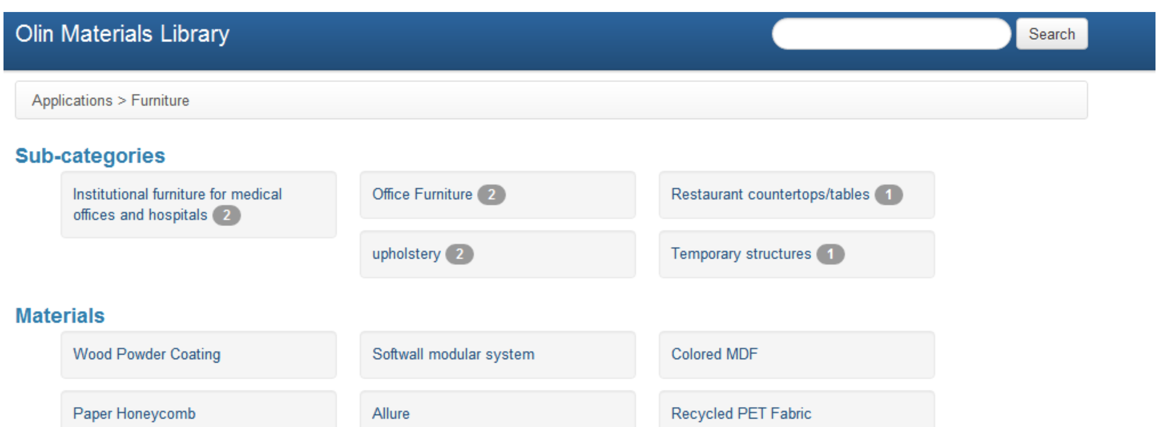

Figure 10 Olin's Materials Samples Database, Sub-category Level

The site was built in the Django framework, which runs on Python, and features an administration panel that allows administrators to edit and update the content of the site without requiring programming. There is a flexible categorization system that allows an administrator to customize where materials and subcategories will appear, as well as what categories are featured in tabs on the home page. Custom metadata types can be created for items if they feature non-standard information.

Django was chosen because it is database- and platform-agnostic, as well as being one of the most common and stable development frameworks in use today. The development process focused on low-maintenance and ease of future development parameters. Django includes a database-agnostic object-relational mapper, so most common data stores can be effectively used with the system. SQLite is used in development for simplicity, but MySQL will likely be used in the production environment for durability. The development versions are self-hosted from Django's development server, but for Olin's production deployment a standard web server such as Apache with mod_python or WSGI will be used for high availability and performance. Version control for the site was maintained in a git repository, which will allow for future developers to flexibly include modifications to the source. Database revisions are handled by the South migration framework. This will allow the site to easily and efficiently be updated over time as features are requested and more time is invested in the project.

The site front-end was built in standards-compliant HTML, javascript, and CSS. The Twitter Bootstrap front-end framework, LESS, and the ubiquitous jQuery framework were used for accelerated development and providing familiar source code to any new developers.

Conclusion

While funds can be dispersed and samples purchased quickly, a true materials samples collection that is organized and accessible both physically and electronically takes time. Further, a useful collection cannot exist in a vacuum. Creating partnerships with faculty members and ties with specific courses is critical to the relevance of a collection. Olin College Library staff have succeeded in collecting samples, have begun processing and organizing them at a deeper level, and now have a plan in place to have the collection become an important part of several courses on campus while having students contribute to much of the collection's future growth.

References

Buck, R. A. & J. A. Gilmore (Eds.), (2010). *Museum Registration Methods 5th Edition.* Washington, D.C.: The AAM Press.

Whitlow, J. (2008). MIT Museum Collections Manual [html]. Retrieved from http://web.mit.edu/museum/collections/manual.html.