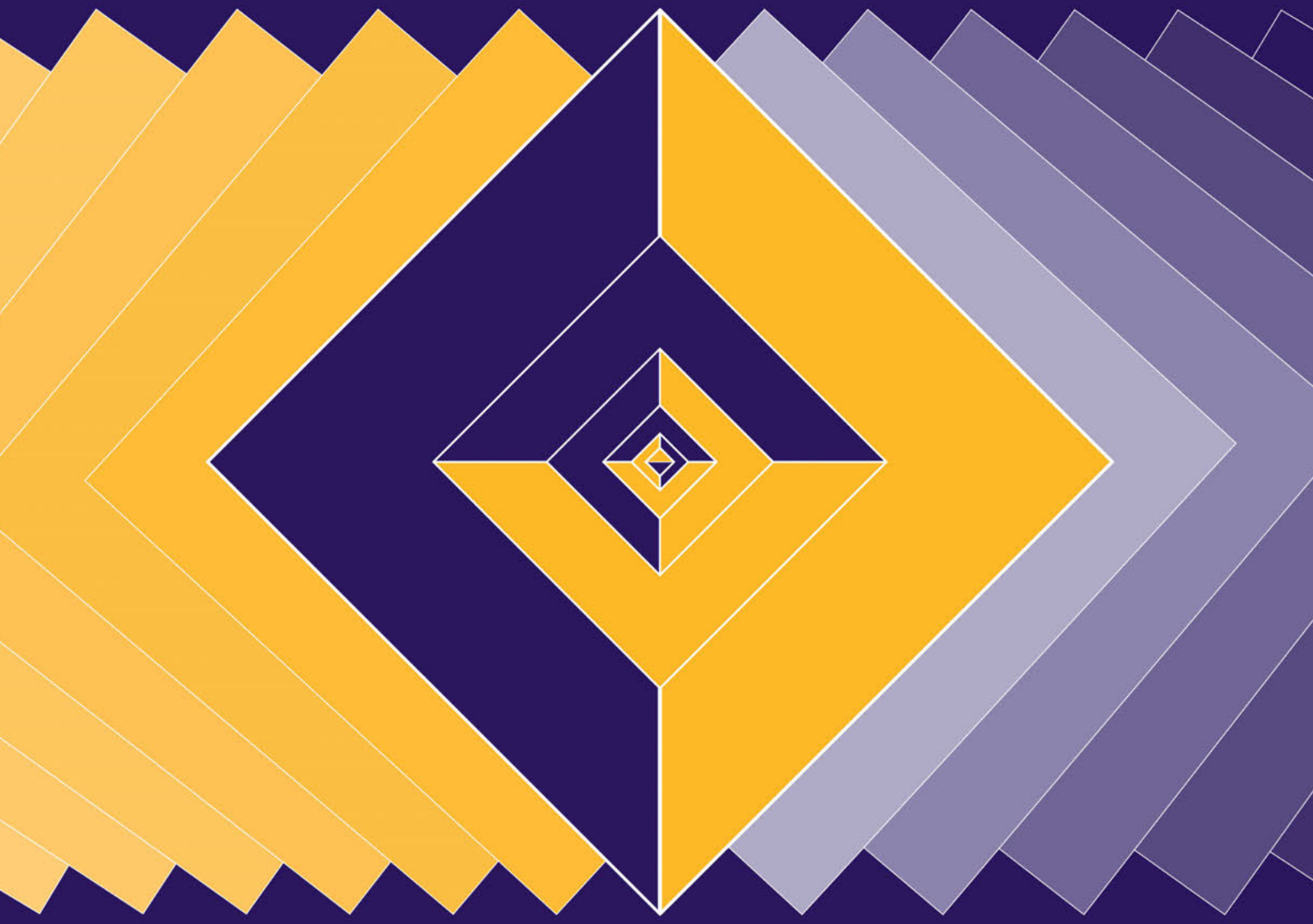
SPEC

Kit 348

Rapid Fabrication/Makerspace Services
September 2015



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Rapid Fabrication/Makerspace Services

September 2015

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SURVEY RESULTS

REPRESENTATIVE DOCUMENTS

Equipment, Software, and Models

Policies and Procedures

User Training

SELECTED RESOURCES

SURVEY RESULTS

EXECUTIVE SUMMARY

Introduction

Rapid fabrication technologies, or "3-D Printing," to use the less accurate but more familiar term, have undergone rapid evolution and are now used for medical implants, prosthetics, teaching aids, information visualization, research on rare/fragile objects, architecture, art, and advanced manufacturing. These technologies are rapidly lowering a number of different barriers faced by researchers and others, barriers that had previously made it prohibitively difficult for most individuals, researchers, and organizations to manufacture objects without significant investment of time and money in training and equipment. Because of these advances, the complexity and range of objects that may now be manufactured has increased precipitously, including easily customized items or precisely replicated physical objects, while the process by which these may be manufactured has flattened, allowing on-site or local manufacture and reducing lead time (in some cases permitting even just-in-time manufacturing processes).

These technologies produce intellectual assets—sensor and digitization data, as well as models and methods—that are potentially valuable to other researchers for future reuse and replication. Moreover, these technologies offer the opportunity to create spaces ("makerspaces") that facilitate research, collaboration, information discovery and management, and a form of technical and information literacy.

Strategic Relevance to Libraries

In the last several years, the interest of libraries in this space has been growing rapidly. Fabrication technologies and makerspaces are strategically relevant to research libraries for at least three reasons.

First, makerspaces represent a unique use of library space. The assessment and renovation of libraries' use of space has been recognized as a current strategic issue for libraries in general. As Joan Lippincott notes in *Research Library Issues*[1], it is essential that library space assessment be informed by campus priorities related to teaching and learning, expanding beyond library-centric thinking to design proactive spaces that engage with student learning more broadly. Makerspaces offer a key potential opportunity for such engagement, while creating spaces that align with the library mission, synergize with other services, and integrate staff competencies like information management.

Second, libraries are increasingly engaging with data management. Digitization and fabrication technologies both make use of and produce research data—data describing objects, models, and the sensor information collected from them. Makerspaces offer a clearly scoped locus for the integration of data management with other services and resources.

Third, we are now seeing fabrication figure increasingly throughout the various stages of the research lifecycle, and there is a clear trend towards adoption in higher education generally.[2] These technologies may be used early on as part of prototyping for research interventions or to embed sensors for research data collection, or later on as part of analysis or research collaboration (e.g., by materializing models for examination and sharing).

Further, libraries have a number of core competencies that are complementary to fabrication:

- Fabrication extends the information lifecycle. Fabrication technologies make information

material and, conversely, help make material objects into information.

- Libraries support the research process. Use of fabrication technologies requires a core set of skills and knowledge (such as databases of models) outside of specific research domains and requires skills and knowledge that are not in the sole domain of any one discipline.
- Libraries promote literacy broadly. Use of fabrication technologies promotes design, science, technology, engineering, art, and mathematics.
- Libraries are responsible for maintaining the scholarly record. The data, digitizations, designs, and models produced as part of rapid fabrication approaches can constitute unique and valuable parts of the scholarly record.
- Libraries provide commonly accessible physical spaces designed for research and learning. Successful makerspaces bring together accessible locations, thoughtfully designed space, curated hardware and software, skilled staff, local information management, and global "reference" knowledge.

Survey Highlights

The goal of this survey was to gather information for senior library staff to support decisions related to engagement with 3-D printing, rapid fabrication and digitization technologies, and makerspaces, in general, and in particular to inform decisions regarding the types of service offerings libraries can provide, resources needed, and evaluation of the service. These results are based on 64 responses from the 124 ARL member libraries (52%) by the deadline of June 12, 2015.

Service Offerings

Makerspaces appear to be of significant interest to ARL libraries. A substantial majority of the responding libraries (41, or 64%) are currently engaged with makerspace service deployment (providing, piloting, or planning the service). Another 11 (17%) plan to investigate these services in the future. Only 12 respondents have no plans to enter this domain (Q1). The respondents that are currently engaged with makerspace service deployment were asked to complete the survey. The others were directed to a question on futurecasting.

Of those libraries engaged in makerspaces, the majority offer, or plan to offer, a combination of core services including reference, training, hardware, scanning, and model repository, while a substantial minority are also engaged in collection development around 3-D models (Q5). In addition to these core services, almost all of these libraries offer, or plan to offer, use of 3-D printers. More than four-fifths support 3-D design and conversion software, and more than three-quarters provide 3-D scanners (Q13, Q15).

While only a minority of these libraries offer additional hardware and services beyond 3-D printers and scanners, the breadth of technologies being explored is impressive (Q5, Q13, Q15). The responding libraries support a wide range of CAD, visualization, animation, drawing, and audio production software, as well as software specific to scanning and printing systems. They provide an even wider range of hardware, including hand tools (carpentry tools, sewing tools, soldering irons, and 3-D pens); electronics (microcontrollers, electronic kits, motors, wearable/soft circuits, and sensors); visualization equipment (digital globes, virtual reality goggles, digital surfaces, and visualization walls); subtractive fabrication (laser cutters and CNCs); large mechanical tools (drill presses, and industrial sewing machines); large format printers and scanners; and drones.

These hardware and software offerings are supported with online resources, reference services, and training sessions. Almost all of the responding libraries offer, or plan to offer, in-person technology training and skill-building sessions. Approximately three-quarters use LibGuides or other resources, supply documentation, or provide reference services (focusing on design, models, and software) to support hardware and software use (Q17, Q18, Q19, Q22).

Implementation and Resources

Libraries investigate makerspaces for a variety of reasons, most commonly because library staff or administration recommended developing these services, or because they were identified as a priority during strategic, space, or renovation planning (Q2). While direct user requests and user need evaluations were a

less common motivator (cited by approximately a third of respondents), almost all libraries expect substantial service use from undergraduates, with four-fifths and half of libraries expecting substantial use from graduate students and faculty respectively (Q2, Q3, Q26).

The responding libraries are funding makerspaces using existing resources. Almost four-fifths fund their makerspaces from their general budget, and 85% use only existing staff to support these services. Fewer than a third of libraries currently charge any kind of fee for the service (Q14, Q30, Q33, Q35).

Offering makerspace services typically requires allocating staff time, purchasing hardware and software, and preparing space. Staffing was most commonly (modally) named as the largest single expense, although substantial clusters of respondents named equipment or materials (respectively) as the largest expense (Q32, Q36).

The median library makerspace service involves three staff members, contributing portions of their time (Q32). Staff are drawn from across the library. Those roles contributing at least 20% FTE to library makerspaces and services include: lab assistant, student technician, lab manager, design architect, digital fabrication specialist, digital media mentor, developer, graduate research assistant, multimedia specialist, arts librarian, science librarian, and even head of circulation (Q33). (The significant staff requirements may explain why most libraries offer limited hours for makerspace services—see Q29.)

Planning also requires a significant investment of staff time. Of those libraries that fielded a service, most reported spending several months or more developing the service, while some libraries reported spending up to a year (Q4, Q6).

Although most respondents did not identify the construction, renovation, or preparation of space as a dominant expense, there were large variations in the reported space required. While the average amount of space used is approximately 310 square feet, the upper range reported was 9000 square feet (Q11).

Evaluation

Libraries' formal evaluations of their engagement with makerspaces were quite positive. Forty percent of the libraries (15 of 38) have conducted some formal assessment, most by collecting usage data, observing of users, and user satisfaction surveys (Q40, Q41). As a result of these assessments, approximately half of the libraries identified the need for altered or expanded services, and none identified the need to eliminate or reduce services (Q43).

Frequently reported challenges clustered around the dual themes of resources and maintenance. Funding and staff time are a recurring challenge, especially because the hardware requires training, adjustment, and maintenance (Q50, Q52). These challenges are manageable—no horror stories were reported, and many respondents encouraged experimentation, patron outreach, and keeping an entrepreneurial perspective. This was articulated well in a number of respondent comments, which note that hardware is not a "turnkey" solution and requires a "DIY [do-it-yourself] ethos" (Q54).

Overall, respondent comments about the role of the makerspace in their libraries are overwhelmingly positive (Q53). They said that makerspaces are "a catalyst for innovation," "a component of scholarly communication," "hubs for participatory and collaborative learning," the "next steps for active learning and presentation of scholarship,"and that they "foster creativity." One respondent crisply articulated a general theme touched on in many of the comments: "A central department-free place on campus for this technology is key, since the applications are so broad… Having a library service solves this problem and opens up the technology to the entire community." There was, however, a note of caution sounded, as well—a number of respondents emphasized that the core competitive advantage of the library is not in providing hardware or simple physical space but in creating an environment that combines service, space, and expertise to foster individual and collaborative "investigation, interrogation, and learn[ing] through doing."

A Rapidly Changing and Challenging Area

As the survey results reveal, many research libraries are engaging with making and makerspaces. This area remains both exciting and challenging. These technologies are rapidly evolving, which presents a challenge to the libraries that need to buy and maintain

them. For example, within roughly the last eighteen months, there have been a raft of 3-D printers and scanners introduced into the market at all price points from hobby-level, through consumer, business, and manufacturing grade. Although consumer-level 3-D printers require relatively little capital investment, more advanced rapid fabrication technology can be expensive, requiring extensive setup and maintenance, as well as dedicated space. Some hardware even requires specialized plumbing, HVAC, or access control.

This technology shift has some advantages. Prices are dropping, and technologies in development have the potential to dramatically improve the capabilities of consumer- and professional-grade equipment—in the speed of printing, ease of use, cost of maintenance, and range of materials. Some of the benefits of these advances may be huge. For example, the ability to use multi-material printing technologies could allow the integration of working electrical circuits in printed objects, which greatly expands the potential types of objects that can be designed, as well as the potential range of applications.

The expertise and skills needed to support makerspaces and services is also complex. Library patrons will need support to determine whether rapid fabrication will be of use to them, discover existing models and design solutions (using specialized databases and collections), alter models or scan or design new ones (using specialized software), select service bureaus, and use locally hosted fabrication tools. They will also need support in managing the data (models) they produce, and in sharing or archiving them. Expertise is also needed to set up and maintain the makerspace tools and infrastructure.

Some of this support involves discovery, data management, and reference interview expertise that is within the traditional training of librarians. However, making also draws on skills and expertise from multiple disciplines, including design, engineering, electronics, and architecture. Moreover, some experience with tool use is highly device-specific and requires tactile feedback; as such, it can be gained only by using the appropriate physical tools. Further complicating matters is the fact that there is little formal guidance available for libraries that wish to engage in the development of a makerspace or services, and there are few established sets of best practices, training, or reference publications that may be used to guide selection and development of these practices.

Finally, the rapid change in technology also impacts both the cost and attractiveness of makerspace service offerings. In the last eighteen months, major retailers, such as Staples, UPS, and Office Depot, have entered into the market both as retailers and as print-on-demand service providers, while former niche leader Makerbot has experienced a substantial contraction. This is likely to have the effect of creating new opportunities for reference and design support, while reducing the attractiveness of services that offer only low-end, consumer-grade printing—that is, those that are already increasingly available to the public.

In sum, while libraries can field small pilot services or experiments in 3-D printing with relatively few resources, support for advanced making can require substantial investment—and investments in hardware involves heightened risk because of the rapid changes in technology. Because of this technological instability, libraries creating makerspaces and services should thoughtfully consider how investments can be made in staff, focusing more, perhaps, on developing expertise and service rather than on providing extensive hardware and facilities.

Discussion

Library Interest is Steady and Substantial

This is the first comprehensive survey of ARL member libraries in this area, so trends are challenging to gauge. Only two other recent surveys have been conducted,[3] and these have substantial limitations in design and coverage. A convenience sample survey of libraries in all classes was conducted in 2013, which found that 41% of libraries sampled had some form of fabrication or maker service while another 36% were planning such services.[4] The results from this SPEC survey indicate that 27% of the responding libraries (17 of 64) are engaged with services in this area and 37% are in the investigation and planning stages. While this is insufficient to establish a statistical trend, it suggests that interest in rapid fabrication/makerspace services is steady and substantial.

Formal Guidance is Limited

The libraries that responded to this survey have constructed guides and tutorials for clients and have identified online books, articles, video tutorials, software, and collections of models that are useful to a broader audience. Nevertheless, existing resources in this area remain sparse. Survey respondents and our own literature reviews revealed that relatively little information is available online or in print that can be used to guide patrons in determining whether rapid fabrication will be useful to them, to help them discover and alter existing models, or to teach them to scan or design new ones, or to support the fabrication of an object from these models. Nor are there established best practices or off-the-shelf solutions for libraries in this area.

We were able to identify some useful online resources, which are listed in the bibliography. However, we would recommend that libraries engaging in this area also participate in maker events—such as conferences and "faires"—to learn directly about emerging uses, trends, and to gain hands-on experience.

Respondents, while reporting generally positive experiences with these services, cautioned that manufacturer service and support is often uneven and that even recent mass-market products require tinkering and maintenance. Running a makerspace requires a willingness to do-it-yourself.

The Audience is Broad

It is, perhaps, unsurprising that we've encountered a wide variety of applications in our interviews with students, staff, and faculty at MIT over the past year. Some use rapid fabrication technologies in medical engineering, while others employ the technologies for such diverse projects as prototyping robotics, supporting collaborative design of a satellite, visualizing information, and even developing new fashions. Meanwhile, other MIT researchers have developed new methods for printing everything from houses, to solar cells, to artificial bones and skin. The ARL survey results, however, make clear that the broad appeal of these technologies extends beyond technology-focused universities, such as MIT. As one respondent put it, "During our pilot phase, we gauged interest from anyone we could talk to, and it became clear that the applications for this technology are so broad that any department could use it."

Outlook

While no trend data is yet available regarding ARL member libraries' engagement with 3-D printing and similar technologies, it is evident from the survey data that considerable effort is going toward mapping and forecasting community needs and developing appropriate library services and resources. Unsurprisingly, resource allocation is a primary concern, given that most respondents report funding makerspaces and attendant costs from existing operating budgets. The rapid advancement of technologies, as well as the increase in readily accessible consumer-level printing services, complicate libraries' ability to invest in and maintain equipment that will serve their communities into the mid-term—on the flip side, however, the novelty of the technology and the rapid expansion of possible applications are characteristics that generate enthusiasm and make the makerspace an opportunity for vibrant community outreach and collaboration.

The center of balance between these potential risks and rewards will vary depending on institutional context—in some cases, individual schools, departments, or labs may provide access to rapid fabrication equipment, and so, in addition to consulting peer institutions regarding the latter's makerspace experiences, it is critical to map existing institutional services (including who can access them) and identify gaps which may be productively addressed by the libraries, whether independently or collaboratively. In order to develop a sustainable model, the rapidity with which technology is changing should be factored into service models realistically, as should the costs of equipment maintenance, staff time related to makerspace supervision, and staff time related to instruction and outreach. Models should also include regular assessments in order to identify areas for improvement and expansion and to ensure responsiveness to user needs in a shifting environment. Finally, the purpose of the makerspace service should be clearly articulated and closely tied to the library's and institution's respective missions to ensure continued relevance.

Certainly, responding institutions appear to recognize that the nature of the technology dovetails with the function of academic research libraries, offering a novel means of engaging students, faculty, and affiliated researchers that intersects with both emerging library roles like data management and traditional functions related to information access and preservation—and, as researchers increasingly incorporate the technology throughout the research lifecycle across disciplines, it will become more and more necessary for libraries to provide expertise and other forms of support in this area.

Endnotes

1 Joan Lippincott and Kim Duckett, "Library Space Assessment: Focusing on Learning," *Research Library Issues*, no. 284 (2013): 12–21, http://publications.arl.org/rli284/12

2 Larry Johnson, et al., "The NMC Horizon Report: 2013 Higher Education Edition." (2014): 1–40, http://www.nmc.org/publication/nmc-horizon-report-2013-higher-education-edition/

3 Gary Price, "Results From 'Makerspaces in Libraries' Study Released," *Library Journal* (Infodocket). (December 16, 2013) http://www.infodocket.com/2013/12/16/results-of-makerspaces-in-libraries-study-released/; PRG, "Survey of 3D Printing in the Library," Primary Research Group (2014)

4 Gary Price, "Results From 'Makerspaces in Libraries' Study Released," *Library Journal* (Infodocket). (December 16, 2013) http://www.infodocket.com/2013/12/16/results-of-makerspaces-in-libraries-study-released/

SURVEY QUESTIONS AND RESPONSES

The SPEC Survey on Rapid Fabrication/Makerspace Services was designed by **Dr. Micah Altman**, Director of Research and Head/Scientist, Program on Information Science for the MIT Libraries; **Matthew Bernhardt**, Web Developer for the MIT Libraries Digital Library Application Development team; **Lisa R. Horowitz**, Assessment & Linguistics Librarian; **Wenqing Lu**, research intern in the MIT Libraries Program on Information Science; and **Randi Shapiro**, assistant to the MIT Libraries Director and the MIT Libraries Program on Information Science. These results are based on 64 responses from the 124 ARL member libraries (52%) by the deadline of June 12, 2015. The survey's introductory text and questions are reproduced below, followed by the response data and selected comments from the respondents.

Rapid fabrication technologies, or "3-D printing," to use the less accurate but more familiar term, have undergone rapid evolution and are now used for medical implants, prosthetics, teaching aids, information visualization, research on rare/fragile objects, architecture, art, and advanced manufacturing. These technologies are rapidly lowering a number of different barriers faced by researchers (and others), barriers that had previously made it prohibitively difficult for most individuals, researchers, or organizations to manufacture objects without substantial investment in obtaining manufacturing skills and equipment, to manufacture complex objects, to offer a wide variety of different objects, to easily customize and individualize manufacturing, to manufacture objects locally or onsite, to manufacture objects with little lead time (or just-in-time), or to easily and precisely replicate physical objects.

These technologies produce intellectual assets—sensor and digitization data, as well as models and methods that are potentially valuable to other researchers for future reuse and replication. Moreover, these technologies offer the opportunity to create spaces ("makerspaces") that facilitate research, collaboration, information discovery and management, and a form of technical and information literacy.

The goal of this survey is to provide information to senior library staff that will support decisions related to engagement with 3-D printing, rapid fabrication and digitization technologies, and makerspaces in general. And in particular to inform decisions regarding the types of service offerings libraries can provide, level of service, level of resource commitment, potential clientele needs, and evaluation of the service. The specific objectives of the survey are to provide systematic, well-structured, baseline information on ARL member libraries' policies, services, investments in, and experiences with supporting fabrication services and makerspaces.

BACKGROUND

1. Which of the following statements best describes your library's current status regarding fabrication/makerspace services? N=64

We provide such services on an ongoing basis	17	27%
We are piloting/testing these services	9	14%
We are actively investigating these services	15	23%
We plan to investigate these services in the future	11	17%
We have no plans to provide such services at this time	12	19%

Comments N=16

We provide such services on an ongoing basis N=6

We have been offering 3-D printing services since Fall 2013.

We have offered 3-D printing to the university since 2003, and 3-D scanning starting in 2005.

We just began piloting the service in late 2014 and are continually testing, but we plan on offering the service as an ongoing program.

We offer mediated 3-D printing and we are in the process of creating a dedicated makerspace for student use.

We only provide a 3-D printing service.

We started a small makerspace in our Hunt Library when it opened in January 2013, outfitted with a laser cutter, 3-D printers, and 3-D scanners—being the first place on campus to offer access to these technologies to any student or faculty member. This makerspace has largely been oriented around providing a printing service for all students and faculty. In June 2015, we will be opening a new space in our D. H. Hill Library. This space will focus on giving hands-on access to the emerging technologies of making, and thus on affordable consumer-level equipment. This space will enable many more students and faculty to directly work with 3-D printing, 3-D scanning, electronics prototyping, and other maker tools. With a program of beginner workshops and easy-to-use tools, we will show that these tools aren't just for engineers and designers, but can have an impact in every discipline. We will partner with faculty to integrate 3-D tools into their curriculum, while also supporting students' interest-driven informal education.

We are piloting/testing these services N=3

The Science & Engineering Library (SEL) is currently providing course-related project prints for students, as well as test prints of other material types for various purposes. At the same time, we are planning more extensive makerspace services as part of our new Digital Scholarship Center.

We are piloting/testing services in the Norlin Commons, and are investigating these services in the Gemmill Library (Engineering, Mathematics, and Physics).

We purchased a single Makerbot Replicator last year to test. We've come up with a plan for implementing a library service based on these devices and are currently seeking support/funding.

We are actively investigating these services N=5

> We are in the midst of preliminary discussions with a campus partner who recently developed a faculty-specific makerspace for students. They have equipment and some staffing, and have expressed interest in expanding. We have space in the libraries that could be re-purposed should a partnership proceed. We didn't have specific plans to provide makerspace services prior to this opportunity arising, so haven't done much research. As a result, I haven't answered any other questions.
>
> We have a design studio created in partnership with the schools of mechanical engineering and industrial design. The studio is a pilot for one piece of a potential multidisciplinary design commons that might include fabrication services.
>
> We have a Scholarly Commons unit and are building the Grainger Engineering Library Informatics, Design, and Data Visualization Center (GLID2).
>
> We have developed a service plan, and purchased initial equipment for testing (with library IT), and hope to implement a 3-D printing service within a year.
>
> We were going to be a host site for a third party 3-D printing operation in Summer 2014 but their business model failed during their pilot.

We have no plans to provide such services at this time N=2

> At this time we have no plans to implement 3-D printing.
>
> There are at least two other active rapid fabrication/makerspace services on campus, one of which is in a building adjacent to the Libraries on campus. Duplication of this service within the Libraries does not appear to be needed or prudent at this time.

If your library is currently providing fabrication/makerspace services, please complete the survey.

If your library is currently pilot testing or actively investigating whether to provide fabrication/makerspace services, please answer as many of the survey questions as possible at this time. Some survey questions are asked in the past tense. Please answer them as if they were asked in the present or future tense if that better applies to your situation.

If your library plans to investigate these services in the future or has no plans to offer such services, you will skip to a question on future casting.

PRE-IMPLEMENTATION

2. What motivated your library to investigate the development of fabrication/makerspace services at your library? Check all that apply. N=40

Library staff recommended developing these services	27	69%
These services were identified as a priority during a strategic (or other) planning process	19	48%
A library renovation project provided an opportunity to develop a space and services	18	45%
Library administration recommended developing these services	18	45%
Library users requested these services	13	33%
A donor wanted to help develop a space and services	4	10%
Other motivation	16	40%

Please briefly describe the other motivation. N=16

A call for volunteers to set up the service was put out and I volunteered to propose a service model and help manage it on an ongoing basis.

A competitive grant was provided by LibraryLinkNJ.

An existing makerspace on campus is looking for a new home and approached the library.

Differs by location. The director of Educational Technology Services approached the Libraries in creating a 3-D printing lab in its Media Commons @ the Knowledge Commons.

Environmental scanning of similar libraries

Interest from faculty, opportunity to centralize services and products of makerspaces being developed

One major source of motivation was Educause's Horizon Report, which has listed 3-D printing and makerspaces in recent years.

Our graduate school wanted to establish makerspace opportunities.

Part of the library's mission is to expose our community to emerging technologies.

Pilot a teaching studio for multidisciplinary design education.

Project in conjunction with Engineering Department.

The library is very interested in digital scholarship centers. The campus is actively pursuing several initiatives in design learning, including building out a network of design learning nodes across campus. We are interested in the library's role in these campus-wide endeavors.

These technologies were available in other schools at our institution, but not in the College of Arts & Sciences. We thought that once humanists and others were exposed to the possibilities, in a low-stress, sandbox environment, changes to research interrogations would follow.

University 3-D printing club expressed interest.

We knew of one other school on campus offering 3-D printing, but this was for program -pecific outcomes. We purchased our first 3-D printer using funds provided by student government. Our first 3-D printing was a class gift to the library.

We noticed the service trend in other libraries. We recognized our patrons were pursuing these services elsewhere on campus. We thought it was a service our library could provide, that it was consistent with our mission and would provide benefits including increasing our knowledge and support of patron projects and research.

3. What type of information did your library gather before deciding whether to test or implement fabrication/makerspace services? Check all that apply. N=40

Investigated equipment, maintenance, cost, etc. of fabrication/makerspace services	39	98%
Collected information from other libraries that provide fabrication/makerspace services	35	88%
Observed other departments that might be affected by digital fabrication services, for example, technology department, printing service department, innovation department, etc.	27	68%
Collected library users' requirements on fabrication/makerspace services	13	33%
Gathered other type of information	12	30%

Please briefly describe the other type of information. N=12

Collected information from institutions that have labs containing 30 or more 3-D printers—Florida Polytechnic Institute and SUNY–New Paltz. Consulted, and visited, MakerBot headquarters.

Collected information from teaching faculty in departments that might rely on fabrication services.

Conducted a literature review.

Due to when we first considered 3-D printing, our focus was placed on the technology and its capabilities.

Investigated other research-oriented fabrication spaces at other institutions. Bought inexpensive equipment and encouraged staff to test it, address their own scholarly questions, prior to launching it for the public.

Looked at local (community) makerspaces and their offerings.

We also looked to other non-library makerspaces including museums, academic departments, and for-profit makerspaces.

We also spoke with Loans Services and the finance office about accepting payment for 3-D printing services. We spoke to various local 3-D printing experts about equipment and critical making.

We are fortunate to have faculty that have provided detailed breakdowns of how the machines would be utilized in their classes. We hosted a "3-D Printing Expo" to bring together interested parties and survey attendees.

We did an extensive literature review for more than a year before deciding to pilot this service ourselves.

We purchased a very low cost printer just to pilot the service. We used that printer to understand the technology, gauge time and service commitments, and patron interest.

We visited several academic institutions that offer digital scholarship services, including NCSU, Duke, Indiana, and Michigan and spoke with Brown, Georgia State, and Calgary.

4. Please briefly describe how much time and effort your library spent on gathering data and planning the development of fabrication/makerspace services (for example, number of months to plan, or number of staff weeks allocated to the project). N=38

We provide such services on an ongoing basis N=16

1+ year to assemble, test, and teach the technologies, plus 6 months to renovate and organize the space.

3 months to plan between myself and my collaborator, the manager of a mobile development lab, who had agreed to host the 3-D printing equipment. We started an environmental scan in May, got the equipment in August, and launched the service in October 2014.

4–6 months with 2 librarian staff members (part-time)

6 months

A working group was formed that produced an interim and final report with recommendations.

About two months planning and grant writing. Following the award of the grant we spent about two months simultaneously waiting for the 3-D printer to arrive and preparing the area.

From conception to implementation, it took us about 6 months to implement 3-D printing as a service.

Gathering data and consulting with other institutions: six months; planning and development of services: three months

It took approximately 2 months to gather data and other information about 3-D printing in libraries, train on the use of the 3-D printer, and develop a policy for the library about the 3-D printer.

Once our IT department felt comfortable servicing the printer, we offered it to the public on a trial basis. Printing was free at first in exchange for completing a survey about what the patron would use printing for, how often they would use it, and how much they would be willing to pay. This only lasted a couple of months. We then bought a prosumer-level printer and continued our trial for a year. We now offer the service on an ongoing basis.

One staff member spent approximately 10 hours a month for one year doing research/literature review, an environmental scan, and talking to staff at other libraries and museums. The department head in our New Media Center took a sabbatical to visit 20 academic and public libraries, five of which offered makerspaces or 3-D printing. She discussed the services with their staff to better understand how we could implement them ourselves.

The Makerspace plan was developed over approximately 10 months at the end of which we implemented our first prototyping services. Since then (7 months), we have been offering these services while continuing planning and implementation of other aspects of the plan with most aspects to be realized by September 2015. Total time from introduction of the plan to implementation: 22 months.

We spent ~40 person hours on the project.

We spent about 100 hrs gathering data and planning the development of the makerspace services. Although this process from our point of view is an ongoing thing.

We spent several months researching other makerspaces and 3-D printing services before receiving funding from the university's undergraduate student government to purchase our first 3-D printer. One staff member was allocated to the project, but received guidance and assistance from library administration.

When we first entered this market, due to the technology being quite new there was little understanding/interest on campus. As such much of our interest came from within the organization resulting in only ~1 month of staff time to acquire funding and implement the system. Moving forward we had a shared interest and multiple staff members stepped in to help support its continued use.

We are piloting/testing these services N=8

A couple of months were devoted to planning/developing a proposal for offering makerspace support through the libraries. Existing services on campus were consulted to determine their scope, audience, and what niches remained that would logically reside in the library. Cost, and business models were similarly investigated, and focus groups conducted with undergraduate and graduate students to elicit the highest priority equipment they would like to have available.

Approximately six months for the Norlin Commons data and planning phase.

Fabrication/makerspace services are provided at a branch library (Science/Engineering) as well as planned for Digital Scholarship Center. Planning process has ranged from three months for branch library to longer term for Digital Scholarship Center, as fabrication will be a pilot service until needs and demands are assessed further.

It took us three months to plan our 3-D printing pilot service.

Not possible to answer this question.

Spent about nine months gathering information, purchasing equipment, and hiring staff.

This has been in some form of active development since about March 2014 for ETS. We had discussed 3-D printing before that, but it wasn't until we began exploring the 36-printer option that we were talking about a true makerspace service in the library.

We have been seriously looking into 3-D printing since Spring 2014. It is primarily me and another colleague that have been doing the testing and outreach (because the printer is in our office), and there are four of us that have drafted a plan for creating a large library service. So, we have been planning for over one year at this point. Since it is just a proposal, no staff time has been allocated, but the proposal calls for a whole new FTE position.

We are actively investigating these services N=14

1–2 weeks of product research, roughly one month of testing in conjunction with other projects. Approximately two months of man hours.

20 hrs total so far

6 months planning

A staff interest group was formed. That group met bi-weekly for a semester. An external grant proposal was developed that took two staff members 10 hours a week for three months. Two internal grants were developed and several (5) staff members devoted 25 hours per week for two months.

Approximately 2–3 weeks spent investigating technologies and meeting with potential third party vendor.

Four months of planning before opening studio, and now ongoing assessment (over three years) as more services are considered.

Ongoing, one staff week

Our systems librarian conducted a feasibility study over the course of a month, reviewing literature, contacting other libraries with makerspaces and connecting with faculties to determine where there may be existing services in place on campus and to gauge the need for a service in the library.

Research continues/is in progress.

Roughly 6 FTE months, over one year.

The GLID2 project has been in planning for approximately one year.

Very difficult to estimate. Probably 100s of staff hours. Have been considering this to one degree or another, with considerable research and assessment, for roughly seven years. Plan to implement within the next year. Exact service details yet to be determined.

We are still in the information gathering stage, and are allotting two months to data gathering and planning prior to piloting/testing.

We've been informally investigating this for 1–2 years, and actively investigating for several months. Library IT also actively investigated this with us during this same period. We plan to continue investigation over the next several months, as both IT and the Learning Spaces Program test a new 3-D printer being purchased.

STATUS OF FABRICATION/MAKERSPACE SERVICES

5. Please indicate the current status for each of the services listed below (in planning stage, in pilot testing, in production, tried but discontinued, or has not been considered). Please make one selection per row. N=40

Services	Planning	In Pilot	In Production	Discontinued	Not Considered	N
Reference services for fabrication (e.g., desk reference, consultations, LibGuides on rapid fabrication, or other online resources	18	2	15	0	5	40
Training services (e.g., workshops and classes)	18	5	13	0	4	40
Hardware (providing and maintaining fabrication and scanning hardware)	13	7	18	0	2	40
3-D scanning support	20	8	11	0	1	40
Model Repository (sharing, publishing, archiving 3-D models)	23	0	3	0	14	40
Collection development (selecting, organizing, appraising, or documenting models)	15	1	3	0	20	39
Total Responses	33	13	19	0	23	40

Please briefly describe any other type of fabrication/makerspace service not listed above that your library is planning, is pilot testing, has in production, or has discontinued. N=17

Planning N=9

Augmented reality

Laser etching, large format printing

Micro-controller kits; loanable video production equipment

Pending approval, purchase of a new 3-D printer to upgrade

Purchase and check out of Arduino kits, Makey Makey Invention Kits, Raspberry Pi computers, and Lego Robotics

Robotics and small programmable electronics

Small CNC machine availability

Vizualization walls, data analysis, informatics support for digital scholarship, 3-D printing, laser cutting tools

Workshops on 3-D design for 3-D printing, critical making, how to render scanning files, how to produce 3-D models from data sets

Pilot testing N=4

Big data analysis, informatics support for digital scholarship

Currently on hold due to broken machine.

Currently we lend a variety of technology at the Steacie Science and Engineering Library that could be used in a makerspace.

Subtractive manufacturing tools; low-cost, DIY scanning and photogrammetry stations

In production N=7

Borrowable prototyping: Arduino, Makey Makey, Raspberry Pi

Device/equipment/tool check out; Digital Media Lab

Microcontrolers, wearables/soft circuits, plane-table mapping

Pending new machine

Prototyping electronics lending and instruction.

Public 3-D printing service

We also provide large format printing and scanning (posters).

Discontinued N=2

3-D scanning was implemented in our 3-D lab, but discontinued because of low demand. May reconsider and re-implement. We purchased some 3-D models and have made them available for use; currently discontinued because of non-use.

We discussed but decided not to have a satellite printing service at the main library.

6. As applicable, for each service please provide the start and end dates of the pilot test, when the service went into production, when the service was discontinued. N=18

Reference N=17

Pilot start date:	Pilot completion date:	Production start date:
		01/01/2013
06/01/2013	08/01/2013	Fall 2013
		12/01/2013
		01/29/2014
08/01/2013	08/01/2014	September 2014
09/01/2013	08/01/2014	08/01/2014
		09/01/2014
		10/01/2014
		10/01/2014

Pilot start date:	Pilot completion date:	Production start date:
06/01/2014	01/15/2015	01/15/2015
		04/14/2015
03/01/2015	05/01/2015	
09/01/2015		
10/02/2015	10/03/2015	10/03/2015
2015	2017	
May pilot within one year.		
Planning		

Training N=16

Pilot start date:	Pilot completion date:	Production start date:
		September 2012
08/01/2013	08/01/2014	September 2014
		01/01/2014
		01/29/2014
03/01/2014	Ongoing	
Spring 2014	Spring 2015	Fall 2015
08/01/2014	12/01/2014	01/01/2015
		09/01/2014
		10/01/2014
01/01/2015		
01/15/2015	02/01/2015	02/01/2015
05/01/2015	08/01/2015	09/01/2015
09/01/2015		
10/02/2015	10/03/2015	10/03/2015
2015		
May pilot within one year.		

Hardware N=24

Pilot start date:	Pilot completion date:	Production start date:
		01/01/2013
		01/01/2013
08/01/2013	08/01/2014	September 2014
09/01/2013	08/01/2014	08/01/2014
December 2013	Ongoing	
		01/29/2014
03/01/2014	Ongoing	
04/01/2014	09/01/2014	10/01/2014
06/01/2014		

Pilot start date:	Pilot completion date:	Production start date:
08/01/2014	09/30/2014	10/01/2014
08/01/2014	Ongoing	
09/01/2014		
		09/01/2014
10/01/2014		
11/01/2014	01/15/2015	01/15/2015
01/01/2015		
01/01/2015		
01/01/2015	06/01/2015	
		02/24/2015
03/01/2015	06/01/2015	
		04/14/2015
06/02/2015	09/02/2015	10/02/2015
2015		
May pilot within one year.		

3-D Scanning Support N=20

Pilot start date:	Pilot completion date:	Production start date:
2012	08/01/2014	Sept 2014
		01/01/2013
		02/01/2014
03/01/2014	Ongoing	
Spring 2014	Spring 2014	
		08/01/2014
08/01/2014		
08/01/2014	12/01/2014	01/01/2015
08/01/2014	In process	Summer 2015 (projected)
11/01/2014	01/15/2015	01/15/2015
01/01/2015		
01/01/2015		
03/01/2015	06/01/2015	
04/01/2015		
04/14/2015	05/14/2015	05/14/2015
06/01/2015		
07/05/2015	09/05/2015	09/05/2015
Anticipated Fall 2015		
2016		
May pilot within one year.		

Model Repository N=6

Pilot start date:	Pilot completion date:	Production start date:
02/01/2015		
Did not pilot this service	na	03/01/2015
05/15/2015	na	na
Discontinued in 2012. May re-pilot within one year.		
Not started yet		
Planning		

Collection Development N=6

Pilot start date:	Pilot completion date:	Production start date:
2015		
02/01/2015		
Did not pilot this service	na	03/01/2015
05/15/2015	na	na
May pilot within one year.		
Not started yet		

Other Service N=7

Service	Pilot start date:	Pilot completion date:	Production start date:
Microcontrolers, wearables/soft circuits, plane-table mapping	01/01/2013	08/01/2014	September 2014
Public 3-D printing service			09/01/2014
Borrowable prototyping: Arduino, Makey Makey, Raspberry Pi	02/01/2015	05/01/2015	06/01/2015
Visualization wall, data analytics, design learning hardware/software	January 2015		
Device/equipment/tool check out; Digital Media Lab			1/1/2015; 6/1/2014
[SIUC did not specify an "Other" service in Q6. Delete this?]			01/29/2014
[Temple did not specify an "Other" service in Q6. Delete this?]	06/01/2015		

DECIDING TO MOVE TO PRODUCTION SERVICES

7. If your library pilot tested fabrication/makerspace services, please briefly describe how you determine whether a pilot project should move from an experiment to a production service or product. N=18

    Costs and usage; no special metrics

Decision to move forward from pilot project to production service based on scalability, capacity (staffing and equipment), demand, reliability, and opportunities for integration with campus research initiatives.

Demand and whether it supplements a campus class or academic program.

During our pilot phase, we gauged interest from anyone we could talk to, and it became clear that the applications for this technology are so broad that any department could use it. Existing printers on campus are typically limited to a single department or faculty member and cannot effectively be used for course assignments or experimentation by our large campus community. Moving to production would allow us to fill that void.

In testing now, will be piloting in a digital scholarship sense this coming year and will see how demand and work proceeds.

It depends on the service. We usually like to work with the students to ensure that the service we are piloting is something they want. We get the students to test and once they have tested it and we get the feedback from them. If the feedback is good we move it to production.

Our existing space isn't a makerspace, yet it has many forms of equipment one would expect in a makerspace. The switch to production was a gradual one as we constantly re-evaluate our service and look for new technologies and directions. Our method of evaluation relies heavily on those in the community using the service. Once we determined the technology was stable enough to deliver reasonable expectations consistently, we made it available to the community. Once released (i.e., in production) we continuously refined our understanding of the technology, refined our pricing model, and looked for new capabilities with the existing equipment or through adding to existing resources. We still do this even 10 years later.

Our first Makerbot printer and scanner were purchased with library technology funds and the second 3-D printer was acquired through an Initiative on Technology-Enhanced Learning grant received by a professor in the School of Business. Students in the Collaborative Design for Innovation course were tasked with developing prototypes for a non-profit organization that is in the process of developing a new snack food. The class was divided into teams of 4–5 students and each team had 5 weeks to create and iterate their design submission. The students worked with New Media Center staff to perfect their design ideas. The students brought in rough sketches or models that they had created in clay, then staff helped them develop their preliminary ideas into 3-D digital files and ultimately into 3-D objects printed on the Makerbot. Because our work with this class went extremely well, we felt that we could offer 3-D scanning and printing services to the broader community.

Still determining.

Sustainable financially and with space and staffing resources; continued user need; equipment functions in a way that can sustain the service; level of staff intervention and equipment maintenance required is reasonable and sustainable.

The quality of the final product needs to meet basic acceptable standards and a preliminary set of policies and procedures must be established.

The service model being used for the makerspace services has existed for the Media Commons video production service since 2007. The same model is being applied to makerspace services in this instance. In that sense, it has been piloted for 8 years. In other ways, our implementation actually is the pilot. Should the makerspace/3-D printers in Pattee be very successful, there may be effort to open more around campus or at other campuses.

We are looking at the overarching campus plans for design learning, fabrication facilities, and visualization and data analytics, 3-D printing, and 3-D scanning.

We offered workshops as part of a pilot/soft launch, but once the space was renovated, we transitioned to production. The transition also included a semester-long speaker series and a redesigned webpage that detailed makerspace options.

We printed a lot of different designs. Our makerspace manager told us when she was ready to move forward.

We tracked the number of jobs and requests via Google forms and gathered patron feedback. Based on this data, we were going to move forward with looking at pay services, promotions, and a collection repository.

We will assess based on the use of the service along with cost to the Libraries and staff time.

When the pilot service met the guidelines we had established for a sustainable public service.

8. If your library did not pilot test fabrication/makerspace services prior to offering them, please briefly describe how you decided to move ahead to provide the production service or product.
N=12

3-D printing services was available in Engineering Department. Lab manager wanted a simple printer to be available in the library.

Data gathering and consultation with other installations was considered sufficient.

Library staff was trained on the 3-D printer prior to offering it as a service. We received the printer from a not-for-profit group and they came to help us with the first demonstration. There were a lot of requests for the service so we simply began offering it from that point.

The campus is investing in a network of design facilities and services; the GLID2 and library will be nodes in this network.

The idea to have a 3-D printing service at the library was already around before I started at the university. My job was to figure out how to make it happen. I wrote a proposal for a service model, which was approved by the chief librarian. I then worked with a project manager in the chief financial officer's office who led me through the implementation of the project. It was not considered a pilot, as far as I know.

We began to receive feedback from our students that this was a service that they wanted. In order to better understand their needs, we met with the different departments on campus who were offering 3-D printing and learned that most students only had access to this technology when they were affiliated with specific courses/programs. Further, there were many disciplines that did not have any access.

We clearly filled a niche that existed on our campus and was not being met by others. Also, the cost of entry for many of the technologies is very low, aside from 3-D printers. Weighing the pros and cons of having Raspberry Pis, for example, can consume more resources than just moving forward.

We did not define the services as a pilot though things rapidly changed in the months after starting the service. We were fairly confident this would be well received.

We felt that the need was present, had a staff member that was familiar with the technology, and had donor interest in getting fabrication going so we went right into small scale production.

We had been hearing about the maker movement in the media/literature. We had just hired a new Entrepreneurship Librarian who suggested the creation of a makerspace, including 3-D printing, in 10/2013. He provided administrators with an overview of current maker activity on our campus and suggested how the library could best contribute to the effort in January 2014. After discussing the overview, the Library Executive Committee decided to ask him and the

supervisor of our copy center to proceed with planning. In April 2014, we purchased a 3-D printer with library funds and began experimenting with it. In October, we offered 3-D printing services to the university community. Business grew steadily throughout the academic year, prompting us to buy two more 3-D printers.

We have the fabrication device to test, but do not as yet have a pilot program developed. Still in planning stages.

We sometimes do not pilot all items, we have the IT staff in the Libraries test and work with the patron to implement.

9. Once a decision was made to implement fabrication/makerspace services, how long did it take your library to bring them online (excluding the pilot phase)? N=19

~6 months

10 months

2–4 months

6 months

Approximately 1 year

Approximately 6 months

Because there was a soft rollout, the service's value was consistently evaluated and not fully committed to until a few years in when we were looking at expanding our capacity and capabilities.

Either immediately (with our 3-D printing service) or within the first semester for most, while others are only mentioned minimally on the website and left to be discovered in person while visiting the lab for another purpose.

I'm not sure when the idea was first proposed, but I was called on to write the proposal in May 2014, we got the equipment in August, and the service was online in October 2014.

It took about 2 months to train, learn about the printer, and bring it online.

It usually takes about 2 weeks to implement a makerspace service.

No decision made yet.

No time at all.

Not yet in place.

Six-month investigation into location, models, and environmental concerns

Six months

The pilot phase was a year. During that time we worked out all the kinks. The decision to implement the service on an ongoing basis changed nothing, so if the pilot phase is not considered in the timeline then it took 1 second to implement.

Varies by service, but it was mostly connected to procurement for hardware, i.e., how long one must wait to get things. For courses, it was a matter of developing content, which also varies by course.

While we were working with the students in the School of Business course, we developed policies and procedures to open up the service more broadly. This included researching pricing models at other schools and how to accept file submissions. Creating the form and payment procedures took about a month, but this period overlapped the pilot phase.

SPACE

10. Please briefly describe where the fabrication/makerspace services are located in your library. N=37

3-D Printing and Laser Cutting are located in a small, dedicated space. Makerspace tools and kits are lent from the circulation desks of two libraries. Workshops and classes are held in multipurpose teaching spaces.

At the Norlin Commons Service Desk. Location at the Gemmill Library is TBD.

Digital Media Commons

Equipment is located in a librarian's office and moved as appropriate.

Grainger Engineering Library Information Center GLID2 for visualization, data analytics, informatics, and 3-D printing with plans to extend digital scholarship services to other areas in the library, including the Scholarly Commons.

In one part of the East Commons, a library commons providing academic social space, collaborative computing, and media services. The planned renovation of the library and the opening of the Clough Undergraduate Learning Commons made some commons services redundant. The design studio took over a group study space.

In the common area of a main public space, behind and including a former information commons service desk.

In the science library

It was added to an underutilized computer lab.

No decisions made yet.

One printer

Our 3-D printing service is co-located near our reference desk. We decided on this location because we have staff at this site every hour we are open and they are able to keep the printer running throughout the day.

Our equipment and staff are centrally located in a multi-disciplinary, media-rich building on campus called the Duderstadt Center. The machines occupy a 300 sq ft section of our larger office space. The room has one large glass door/wall (~20 ft long) that opens to a central collaboration area and a point of high traffic. The space is connected to a UPS to smooth out power spikes and outages, which can negatively impact a print. The printers each have their own circuit with equipment associated with the post process (tanks, sifters, ovens) share an additional circuit. Core staff and student staff are in the immediate space to facilitate monitoring and troubleshooting.

Our five 3-D printers, two 3-D scanners, sewing machine, and soldering stations are all located in a locking room within our library that was previously a collaboratory computer lab. In the open library area there are computer workstations, desks and chairs for patron use, and a design and modeling center with drawing/sketching/building supplies.

Our media center

Planned to be located in our Scholarly Services unit.

Proposed areas include: 1) a room on the main floor of a branch library where most of our STEM materials and expertise are located; 2) a room within a group study/collaborative project space in the main library.

Science and Engineering Library in an office space (not public)

The 3-D printer is located in an empty office in our library systems department.

The 3-D printing and scanning hardware/software are at the circulation desk of the Science Library, a branch library on campus.

The 3-D Printing Lab is being planned for Room W136 in the Libraries' Knowledge Commons at University Park. Penn State Hershey: in instruction lab.

The Digital Scholarship Center is roughly 2300 square feet and the makerspace services occupy a bench seating area along a wall that covers the space and a table for 3-D printing. All of this can spill out into the rest of the space if needed.

The machine(s) are in an area designated for experimentation with all types of devices, but they are not yet available to the public.

The makerspace services are located in the New Media Center, which is a unit in the main campus library.

The makerspace will be just inside the entrance to the Engineering Library, to allow for high visibility and impact.

The plan is to house at the Fine Arts Library.

The public printing service is offered through the Lyons New Media Centre in the main library (Mills). The makerspace is in the Lewis & Ruth Sherman Centre for Digital Scholarship in the same building.

The Science Help Desk

They are in a public space on the second floor of the library.

We added to the services of the Copy Center which already offered copying, printing, scanning, plotting and the Espresso Book Machine. This is located in a high-traffic area.

We are now planning for services to be launched in an area on the main floor of the main library building that was once occupied by copy services and is now vacant.

We have an information commons and that is where the makerspace is located.

We have identified space adjacent to our learning commons that we plan to have renovated for a makerspace.

Will begin initially as a staff-mediated consultation service, then may move into forthcoming Digital Media Lab in main public area of the library.

Within our Student Multimedia Studio, a multimedia lab that is available to all currently enrolled students.

Within something called the MADLab (mobile application development lab) which isn't technically part of the library system. It is staffed by one person and his job is to help people develop mobile apps. I think he was tapped to host the machines because it is a secure, private space within the library. He would also be able to keep an eye on things. We only have the 3-D printers, it's not really a "makerspace" so much as a desk with two printers on it. The rest of the space is quite large and it's mixed use. There are a couple rows of large monitors and an instruction space. We also use the lab to deliver training sessions.

Yet to be determined.

11. Please enter the square feet of the physical space of your library's makerspace. N=26

Square feet

Minimum	Maximum	Mean	Median	Std Dev
3	9000	949.33	312.50	1860.84

Additional comments N=2

It's not in a room, it's on an open floor.

Undecided, but expected to be about 30 x 50 ft.

12. Are fabrication/makerspace services in your library associated with or hosted by other organizations? N=38

Yes	6	16%
Not yet, but they will be	4	11%
No	22	58%
Not yet determined	6	16%

If yes or the services will be, please identify the organization and briefly describe its role in these services. N=10

A Design Center building and other areas on campus.

A makerspace that is currently a partnership between our faculty of Engineering & Applied Science and our Business School.

Engineering Department

Graduate school provided all funding.

Schools of Mechanical Engineering and Industrial Design will provide some of the necessary staff and funding to have 3-D printing in the library.

See above. I developed the service in collaboration with the manager of the MADLab, which is housed inside the library. We manage the service together. Since he has an office in the MADLab, he's around more when people are using the printer. He also takes responsibility for changing the filament and handling the Raspberry Pi remote monitoring system. I manage the reservation systems and keep our list of certified users updated. I evaluate and assess the service. We both run safety training, work on improvements, respond to reference questions, and speak about the service.

Student organization will provide troubleshooting support for the hardware.

The 3-D printing lab in the Libraries was conceived and developed by the university's Education & Training Services (ETS). They oversee the Media Commons, which has been part of the Libraries' Knowledge Commons since it opened in January 2012.

The library makerspace is coordinating services with a larger creatorspace group on campus to offer a variety of technologies in various locations. We have a uPrint SE Plus printer on loan from them until the campus space is ready to

open. We work collaboratively with the campus creatorspace's program manager and her office is temporarily located in the library. We jointly submitted a successful grant proposal to conduct a Maker-in-residence program.

The university's 3-D club is interested in partnering with us.

Please enter any additional comments you have about the location, size, or arrangement of your library's fabrication/makerspace services. N=16

3-D printing is noisy. Think about this when you are deciding where to place them, especially if you plan to schedule workshops in the same space when they are running.

It's only a 3-D printing service. The fact that it's in the MADLab reflects a kind of "collaboration of convenience." The MADLab's primary role is to develop mobile apps.

Makerspace services are a good fit with the Digital Media Commons. The 3-D printing is one of the services available through the service desk operated by student assistants (referred to as Digital Media Mentors).

Right now they exist in a spare office.

The 3-D printer is located in the office, but it is often taken out of the office and transported around the library and campus on a cart that holds the 3-D printer, filament, examples, and accessories.

The makerspace size above is not just used for makerspace activities.

We are currently in the process of building a much larger facility that is closer to 265 square feet.

We are in the preliminary planning stages to identify a makerspace.

We are opening a second dedicated space this summer that will be approximately 900 square feet and will offer instruction space for 20 people.

We have three pieces of equipment (2 printers and 1 scanner) and they are located in a multi-purpose staff area. It is not a separate, dedicated space, although we would like to have dedicated space in the future. The equipment moves around quite a bit, depending on whether we are demonstrating for a class or doing outreach.

We have at least seven library areas that could potentially host the service. Preferably, we would have a large room or series of rooms with computers, around 40 printers, presentation space, meeting space, and office space.

We have not yet determined how much space to allow for these particular devices. They will be located in a room that presently houses other hardware for student/faculty use.

We have the printers on a tall table facing the public to attract attention. We get a lot of interest and new users because people are able to see the printers in action. Since you cannot always tell what the printout will look like in the end, we also have a monitor facing the public that shows the final product.

We will be building a physical "makerspace" connected to the Copy Center which will also serve as a classroom for instructional programming.

We would love it if we had a more flexible space with a door than could lock with card key authentication system. As it is, our equipment can only be used when the space is staffed, but we would love to let trained users in whenever the library was open.

While any 3-D printing service will be operated by the library's Learning Spaces Program (with support from library IT), other staff across the library have also hosted Maker Fairs and other maker events/activities.

HARDWARE AND SOFTWARE

13. Please check all the fabrication equipment that is/will be available for use in your library. N=38

3-D printers	37	97%
3-D scanner	28	76%
Hand tools	14	38%
Laser printers	11	29%
Laser engraving	4	11%
Cutting system	4	11%
CNC milling machine	3	8%
Ultrasound cleaners	1	3%
Other equipment	15	40%

Please specify the other equipment. N=15

3-D pens, Leap Motion Controller

An Arduino starter kit is on reserve.

Arduinos, Raspberry Pis, and various shields; sewing machine; filament recycling machine (to come)

Arduinos, Raspberry Pis, digital cameras, sensors, Oculus Rift, etc.

Available Hardware: Mac Pro computers, gaming PCs, Makerbot Replicator 2 3-D printer, Nextengine HD 3-D scanner, Cannon HD camcorders, Sure Digital microphones, WACOM graphic tablets, SD card readers, Magic Planet Digital Globe, Newmark NS6 DJ mixer/controller, SMART Custom Digital Surface, contemporary and legacy gaming consoles

Drill press, Dremel tool, soldering irons, industrial sewing machine

Electronic kits (e.g., Arduino, Intel Galileo, littleBits, Makey Makey, Ototo Musical, and Raspberry Pi), sewing machine, and soldering capability for circuitry work

Electronic soldering/design equipment

Good Glass, Oculus Rift, and a small drone

Large-format printers and scanners (poster)

Microcontrollers

Not yet determined.

Soldering, sewing, modeling

Various motors, switches, etc. all for physical computing work around the Arduino and Raspberry Pi platforms.

Visualization equipment

14. Does your library charge for using any of this equipment? N=39

Yes	11	28%
Not yet, but we plan to	5	13%
No	12	31%
Not yet determined	11	28%

If yes or you plan to, please specify which equipment and briefly describe the fee structure. N=16

$1.50/half hour of reservation time on 3-D printer. The 3-D scanner is free.

3-D printing: we charge $0.10/gram to recover costs.

3-D printing costs 25 cents/gram.

3-D printing will be charged by weight.

3-D printing, have not yet decided on the fee structure.

Cost of materials for 3-D printing: $1.00 base fee plus 15 cents per gram for a printed item

For each object that is printed, we weigh the object and charge a per gram fee. There is also a setup fee that is charged.

Just for the 3-D printing.

Laser printers: per page; 3-D printers: based on volume

Services are broken into two tiers representing full-service and self-service models. Self-service models require the user to provide their own consumables while we provide access to working equipment free of charge. In the case of 3-D printing, our full-service model is derived from consumables (model material, support material, build plates, peripheral supplies, etc.) Our scanning service is based on consumables and staff time. More specifically, a user is charged a fixed rate per hour with a minimum of 2 hours. This rate includes student wages and markers required for the scanning process.

Some 3-D printing and scanning

The 3-D printer: We haven't figured out the fee structure yet (maybe per material weight and print time).

The charges primarily cover our costs for supplies.

We charge $.10 per gram for the filament and a setup fee of $5.00.

We charge based on material used, incorporating machine, maintenance, and staff costs, except where grant or donor funded. The new space will utilize a different model where the equipment is free to use, but will charge for consumables.

We had grant funding for the 2014–2015 academic year, but are looking at models for charging to cover material costs (i.e., price by the cubic inch or gram for 3-D printing materials.

Answered No N=1

So far no, but if students print multiple projects and use filament quickly, we will ask them to purchase their own spools of sanctioned PLA.

15. Please check all the fabrication software that is/will be available for use in your library. N=36

3-D design software (e.g., Sketchup, TinkerCAD)	32	89%
3-D conversion software (e.g., 123-D Catch)	29	81%
Other software	15	42%

Please specify the other software. N=15

3-D scanning, laser cutter software

Adobe CC, SketchUp Pro, Rhino 3-D, 3-DS max, NextEngine ScanStudio HD, Simplify 3-D, Netfabb

Arduino freeware

Audio Production: Pro Tools 11, Adobe Audition, Audacity, Garage Band Music Composition & Notation, Finale, Sibelius 7.5. Productivity Software: Microsoft Office 2011, Adobe Acrobat. DVD Authoring: Adobe Encore, iDVD. Video Production: Final Cut Pro X, Adobe Premiere Pro, Adobe After Effects, Adobe Speed Grade, Adobe Prelude, iMovie. Video Conversion: MPEG Streamclip. Web Development: Adobe Dreamweaver, Adobe Fireworks, Adobe Flash Pro, Adobe Flash Builder, iWeb. Graphics Editor: Adobe Photoshop, Adobe Illustrator. Text & Source Code Editor: Sublime Text. Animation & 3-D Graphics: Autodesk Maya, Autodesk Mudbox, Blender. Desktop Publishing: Adobe InDesign.

Autodesk 3-DS Max, AutoCAD, Blender, Meshlab and 3-D printer software (Cura and Makerware)

Blender, kokopelli (Mac only), MakerBot Desktop, Maya, MeshLab, meshmixer, netfabb, OpenSCAD, PyMOL, SketchUp, UCSF Chimera

CAD, GIS, 3-D modeling

Cubify Invent, Cubify Design, Cubify Sculpt, Onshape

File repair software: meshmixer

May be viewed as conversion software, but medical extraction software and mesh cleanup packages like meshlab, magics, etc. are available.

Pro-Engineer, AutoCAD, IntelliCAD, MatLab, Mathematics, SolidWorks, and others

Software that repairs and modifies 3-D models (e.g., Netfabb, Meshlab); Software that slices and preps models for printing (e.g., Makerware, MatterControl)

Solidworks, AutoCAD

We have a 3-D lab with software listed at the following URL: http://library.ttu.edu/services/technology/soft.php

We really don't make any design software available. We encourage our users to do all the design and conversion work on their own and come to the lab ready to print. We do hope to change this and offer more design workshops and support in the future.

16. Does your library charge for using any of this software? N=37

Yes	0	—
Not yet, but we plan to	1	3%
No	28	76%
Not yet determined	8	22%

Comments N=5

Any paid software would likely be standardized and available on all of our supported computers and lending laptops.

Have campus license agreements with vendors.

I doubt we would charge to use design software.

No charging yet, but some expensive licenses may require buy-in from partners and heavy users.

We only teach free software.

REFERENCE AND DOCUMENTATION

17. Does your library have any LibGuides or other pathfinders that include specific mention of rapid fabrication technologies? N=39

Yes	18	46%
Not yet, but we plan to	11	28%
No	3	8%
Not yet determined	7	18%

18. Does your library have a collection of rapid fabrication technology documentation, books, manuals, databases, or other resources? N=38

Yes	20	53%
Not yet, but we plan to	8	21%
No	2	5%
Not yet determined	8	21%

If yes or you plan to, what is/will be the depth of the collection? N=26

Basic information level	11	42%
Study or instructional support level	10	39%
Research level	3	12%
Minimal information level	2	8%

Comments N=9

It's a mix of technical manuals, research on 3-D printing, critical making, and rapid prototyping, and even leisure sci fi on topics related to 3-D printing.

Not sure at this point, currently have a few ebooks, and some instruction manuals at science library.

Small collection of print materials (e.g., instruction guides) and a number of ebooks

Unknown, I would have to defer to a librarian who would be involved.

We have a small and growing collection of books on micro controllers (e.g., Arduino, Raspberry Pi), 3-D printing and scanning, soldering.

We have an institutional subscription to lynda.com.

We have purchased a small book collection (about 50) to support these activities and have begun developing LibGuides.

We have purchased several books on rapid fabrication.

We subscribe to ProQuest's Safari Books and the lynda.com library, which both have excellent resources for 3-D technologies and rapid prototyping.

19. Does your library provide fabrication/makerspace reference services, such as model selection and design consultation? N=39

Yes	17	44%
Not yet, but we plan to	10	26%
No	1	3%
Not yet determined	11	28%

If yes or you plan to, what reference services are/will be offered? Check all that apply. N=31

Design consultation	23	74%
Model searching	21	68%
Model processing consultation	21	68%
Software selecting	20	65%
Model selecting	18	58%
Software searching	18	58%
Software downloading	9	29%
Other reference service	4	13%

Please briefly describe the other reference service. N=4

Project scoping, programming, file conversion, model creation with photogrammetry

The Gemmill Library plans to provide fabrication/makerspace reference services. The Norlin Commons provided the services during the pilot phase.

Unsure, it is too early for us to know.

While we don't directly provide this service in the library, we have partnered with campus IT, which is able to provide support on model design.

20. Who is/will be responsible for offering these reference services? Check all that apply. N=33

Technology librarians working in the makerspace	15	46%
Reference librarians with 3-D printing knowledge	14	42%
Outside experts (experts outside library, or outside the parent institution)	7	21%
Other staff position/category	24	73%

Please specify the other staff position/category. N=24

At different levels, paraprofessional staff, MLIS student resident, paid graduate student assistants

Digital Media Consultant (Management and Professional Staff); Digital Media Mentors (student assistants)

Graduate student consultants

I am a staff member who oversees science reference services of which 3-D printing is one.

IT staff

IT staff that works in the Libraries

L3 staff member

Library Assistant IV, Makerspace Coordinator & specialized student employees

Library assistants and student assistants

Library's Technology/Media Specialist and the Digital Media Lab's specialized student workers

Manager of the MADLab, graduate student library assistants

Media Support Technician

Multimedia specialists from central campus IT organization (Information Technology Services)

Multimedia Specialists in our New Media Center

One library associate

Reference Assistants

Resident staff experts and trained students

Student staff and full-time manager of Student Multimedia Studio

Student Tech Assistant and others TBD

Student workers

Support staff and student technology assistants

Technical staff and student staff working in the makerspace

Vizualization and Data Specialist

Volunteers from RSO's

21. Does your library document models and designs that users have created? N=38

Yes	5	13%
Not yet, but we plan to	13	34%
No	7	18%
Not yet determined	13	34%

If yes or you plan to, which library staff are/will be responsible for documenting these files? Check all that apply. N=17

Makerspace librarians	8	47%
Archive librarians	1	6%
Other staff category	12	71%

Please specify the other staff category. N=12

Digital Science Librarian

Graduate student assistants for website, repository librarian for institutional repository

Library assistants and student assistants

Library's Technology/Media Specialist and the Digital Media Lab's specialized student workers

Makerspace staff

Multimedia specialists from central campus IT organization (Information Technology Services)

Multimedia Specialists in our New Media Center

Reference Assistants

Resident staff experts and trained students

Support staff and student technology assistants

TBD - Gemmill Library

Technology librarians, vizualization staff, Research Data Service staff

FABRICATION TECHNOLOGY TRAINING

22. Does your library offer workshops or classes on how to use fabrication equipment or software, and/or other skill-building sessions? Please make one selection per row. N=38

Workshops/Classes	Yes	Not yet, but we plan to	No	Not yet determined	N
Using fabrication software	15	9	2	11	37
Using fabrication equipment	11	12	3	9	35
Other skill-building session	13	6	4	12	35
Total responses	19	15	7	13	38

If you selected Yes/Other skill-building session, please specify the skill. N=13

3-D scanning, 3-D modeling, and electronics work

3-D design, Arduino/electronics prototyping

Arduino IDE, basic electronics

Basics of 3-D CAD design, basics of 3-D scanning/photoalignment, basics of microcontrollers

Description of basic applications

Design principles

Discussion of other applications for 3-D printing and scanning

How to use the service (make reservations, continue certification process)

In our software classes we briefly go over designing for printing. When designing a model, you should always consider the manufacturing process.

Intro to microcontrollers, intro to wearables and soft circuits, using DSLR camera, plane-table mapping, screenprinting

Introduction to Arduino

We offer multiple levels of training with multiple channels depending on the student's needs. We offer open workshops, online webinars, course lectures, online videos, and a multi-tier badging track open to all students. Additionally, 3-D modeling, scanning, photogrammetry learning opportunities are offered.

We teach how to use the 3-D software and also how to scan

If you selected Not yet, but we plan to/Other skill-building session, please specify the skill. N=5

Digital Media Lab and equipment sessions like: What could you do with a Raspberry Pi or Oculus Rift?

Economics of 3-D printing in relation to entrepreneurship and tech development

Equipment, software, and other skills as the field develops

Possibilities include vector-based design (for laser cutting and vinyl cutting) and an introduction to circuitry.

Visualization wall training, design technologies and software, 3-D software, presentation and data analysis software.

23. If your library does or plans to offer workshops or classes, who are/will be the instructors? Check all that apply. N=30

Instructors	Using fabrication equipment	Using fabrication software	Other skill-building session	N
Librarians working in the makerspace	17	16	13	18
Teachers outside the library who teach 3-D printing-related courses	7	9	8	10
Librarians working in other departments	3	2	8	8
3-D printing experts outside the library	5	6	5	6
Other staff category	17	20	13	20
Total Responses	25	27	20	30

If you selected Equipment/Other staff category, please specify the category. N=16

Graduate assistants

Library assistant or student assistant

Library associate in charge of the makerspace area

Library's Technology/Media Specialist and the Digital Media Lab's specialized student workers; possibly IT staff

Management and Professional Staff and student assistants (support staff)

Manager of the MADLab, GSLAs

Media Commons multimedia specialists from central IT organization

Media Support Technicians

Multimedia Specialists in our New Media Center

Student consultants

Students involved in maker organizations

Support staff and students

Technical staff/students working in the makerspace

The current plan is to co-teach and co-develop workshops with one librarian and one non-librarian support staff. Our first class in 3-D modeling was taught by a local expert that we paid.

Training is provided by trained student and resident experts of the Lab.

Workshops will be offered on a variety of topics, methodologies, and software.

If you selected Software/Other staff category, please specify the category. N=14

Graduate assistants; staff with design software expertise

Library assistant or student assistant

Library's Technology/Media Specialist and the Digital Media Lab's specialized student workers; possibly IT staff

Management and Professional Staff and student assistants (support staff)

Manager of the MADLab, GSLAs

Media Commons multimedia specialists from central IT organization

Media Support Technicians

Multimedia Specialists in our New Media Center

Student consultants

Student employees

Students involved in maker organizations

Support staff and students

Technical staff/students working in the makerspace

Training is provided by trained student and resident experts of the Lab.

If you selected Other session/Other staff category, please specify the category. N=9

Library assistant or student assistant

Management and Professional Staff and student assistants (support staff)

Manager of the MADLab, GSLAs

Media Support Technicians

Student consultants

Student employees

Support staff and students

Technical staff/students working in the makerspace

Training is provided by trained student and resident experts of the Lab.

24. Does the library charge participants for any of these classes or workshops? N=38

Yes	1	3%
Not yet, but we plan to	0	—
No	30	79%
Not yet determined	7	18%

Comments N=3

Fee might be charged for Raspberry Pi workshops, if needed, though an initial batch of Raspberry Pi sets will be available in the library's Tech Lending Program.

Students pay for the credit class in 3-D design, but not for the workshops.

We may charge if workshops require consumable materials exceeding $5–10.

25. About how many rapid fabrication technology classes and/or workshops does your library offer/plan to offer on average per month? N=24

Average number of classes/month:

Minimum	Maximum	Mean	Median	Std Dev
0	5	1.92	1.00	1.50

Classes	N
0	3
1	10
2	4
3	1
4	5
5	1

Please enter any additional comments you have about fabrication technology training. N=10

1 every 3 months

Contents of training sessions vary based on the expertise and interests of the student assistants currently employed as Digital Media Mentors. Attendance and interest in training sessions continues to increase, particularly for 3-D printing workshops.

Currently rate is one workshop a semester, but that will rise when we are fully functional in the coming year.

During the Spring 2015 semester, we offered 2 sessions for embedded class support for specific assignments and 5 workshops open to the entire campus.

It is too soon to be specific about the types of training we will be offering. A new hire will be in charge of this once the position is filled.

Mostly at the start of semesters with advanced classes following. For the new space, we will have safety workshops with minimal equipment training that will be required before users can be certified to work independently in the space. These workshops will be numerous, and not included in the total above, especially at the beginning of each semester.

These suggestions are in a proposal to purchase a new printer for the Norlin Commons.

We have only offered a few workshops about 3-D modeling. Two were in spring of 2014 and wer open to all members of the university community. The third was a session held during our library's day of seminars for faculty and graduate students.

We plan to offer much of this as online modules, so the schedule doesn't apply.

Yet to be determined.

USERS AND USER OUTREACH

26. Who are (or are expected to be) the main users of fabrication/makerspace services? Check all that apply. N=38

Undergraduate students	36	95%
Graduate students	32	84%
Faculty members	23	61%
Staff	15	40%
Postdocs	10	26%
General public	6	16%
Other user category	4	11%

Please specify the other user category. N=4

Anyone that the library serves can also use these services.

Library Staff

Local K-12 students

Not yet determined.

27. If your fabrication/makerspace services are at a point where you want to encourage growth in users and community engagement, please indicate whether your library uses, plans to use, or has no plans to use each of the outreach activities below. Please make one selection per row. If your services are not yet at this point, continue to the next screen. N=27

Outreach Activities	Uses	Plans to use	No plans to use	N
Presentations	13	12	2	27
Build sessions	5	13	7	25
Show & Tell	6	17	2	25
New project nights	0	10	14	24
Meet & Greet	7	9	8	24
Food & Drink	1	10	12	23
Skill-building workshops	14	11	2	27
Competitions	1	13	11	25
Open make sessions	0	19	5	24
Maker fair participation	7	10	8	25
Other activity	7	3	2	12
Total Responses	16	26	17	27

If you selected Uses/Other activity above, please specify the activity. N=6

Article in university's electronic newsletter "UToday"

Demonstrations/tables at campus events, display cases

Social media

We allow a maker-themed student group to use our space for meetings.

We participate in local events, though not Maker-Faire.

We've presented at local events such at the Tucson Festival of Books and we are also presenting at local, regional, and national conferences to share our experiences.

If you selected Plans to use/Other activity above, please specify the activity. N=3

It would depend on staff availability, but we would be interested in nearly all of these activities.

We plan on having our student employees become ambassadors for this service and will encourage them to develop a plan for outreach.

We will solicit faculty to involve our service as part of their ongoing curriculum. Our focus is on being an academic support.

Additional comments N=2

The new makerspace has a soft opening in mid-June with a small ribbon cutting, and small reception for students and Friends of the Library. When students come back for the fall semester, we will have a full slate of events associated with the opening of the space.

We hold weekly demonstrations in our library lobby, showing our 3-D printers. We have held one 3-D printing competition in the past, challenging users to design a gadget that would have market value and meet a need. We have also participated in our university's Maker Faire twice to increase exposure to our service. We hope to hold maker workshops in the future.

28. If you have already had some outreach activities, please indicate up to 3 that have been most popular with users. N=22

Presentations	13	59%
Show & Tell	10	46%
Skill-building workshops	9	41%
Maker fair participation	7	32%
Meet & Greet	6	27%
Build sessions	1	5%
Open make sessions	1	5%
New project nights	0	—
Food & Drink	0	—
Competitions	0	—
Other activity	3	14%

Please briefly describe the other activity. N=3

Idea sessions for planning

New faculty, grad, and undergrad sessions. Collaboration with Architecture school and Teaching Resource Center.

Social media, we have a hashtag #gerstein3-Dprinting where people can share their print jobs.

Please enter any additional comments you have about users and user outreach. N=11

A Libraries Fellow and CRDM Graduate Assistant will help develop workshop, curriculum, and outreach programs for the space.

In Science/Engineering Library, targeted users include faculty and undergraduates. Presentations included: Introduction to 3-D Printing & Presenting the Raspberry Pi.

Increase in number of users with course-related or research-related interests

Our 3-D printing training sessions continually sell out and we always have to worry about scale at our institution. We don't do a lot of promotion beyond the website and social media. We have been considering doing a show-and-tell event in the library lobby, but we haven't been able to take a printer out of the service for an extended time yet (too busy!)

Partner with student organizations.

The next phase of the Norlin Commons pilot would include greater outreach.

We are also in contact with other units on campus that offer some of these services and the student 3-D printing club.

We held an event on the uses of 3-D printing in research, campus-wide, and it garnered a good deal of interest and exposure. We also host our Master of Arts in Educational Technology practicum workshops.

We hosted a 3-D Printing Expo day for 2 hours in the Research Commons at one of our libraries. Tables included MakerBot and the 3-D printing student club on campus. Many people stopped by, and we were able to capture interest through a survey.

We plan to institute project nights or show & tell opportunities. There are multiple student-run maker communities on campus, thus we are exploring if there is still a need for us to fill that need.

We took our 3-D printer and scanner out to four academic departments for show and tell sessions. The head of the New Media Center also gave demos to the Student Library Advisory Council and the Library Board.

SERVICE HOURS AND STAFFING

29. Are fabrication/makerspace services available all the hours the library is open? N=37

Yes	3	8%
Not yet, but they will be	5	14%
No	19	51%
Not yet determined	10	27%

If no, please briefly describe when services are available. N=14

3-D printing and scanning is currently a production service mediated by staff in the New Media Center. Hours can be found here: http://www.library.georgetown.edu/hours/gelardin

8am to 9pm M–Th, 8am to 6pm F, 10am to 6pm Sat

Existing production makerspace: 2–7pm, 6 days a week. The new "workshop" makerspace will be open: Sun–Thurs 10am–10pm, Fri 10am–6pm.

Hours have not yet been determined but plans are Sunday (1–9pm), Monday to Thursday (9am–9pm) and Friday (9am–4pm), during the academic year (Fall/Spring semesters).

Monday to Friday, 9am to 4pm; consultations can be arranged outside these times.

No service at nights and weekends.

Not fully determined, but unlikely initially.

Only available during MADLab hours, which are Mon–Fri 9–5.

Regular semester: 8am–1am Monday–Thursday, 8am-8pm Friday, 10am–6pm Saturday, 10am–1am Sunday.

Right now, 1–7pm Monday–Friday or by appointment.

Services are available all hours that the Student Multimedia Studio is open, which is 7 days per week during the school year.

Services are available during the day M–F. Sometimes prints are allowed to run overnight if very long. Also, outreach activities occur at other times as well.

Some resources are available 24/7, while support and consultations are limited to the Lab's hours of operation (9am–6pm, M–F). Full service submissions are queued up to make best use of unsupervised time.

The hours are within the library schedule hours with a margin on either side.

Additional comments N=3

It is open from 8am–5pm for anyone and from 5pm–11am for users that have been trained to use the space by themselves.

The library has not yet determined fabrication/makerspace hours.

We will be adding evening and weekend hours.

30. Please indicate who has been involved in developing fabrication/makerspace services at your library. Check all that apply. N=37

Librarians	33	89%
Library support staff	29	78%
University or parent institution partners	13	35%
Other academic institution partners	13	35%
Other external partners	4	11%
Archivists	0	—
Other developer	6	16%

Please specify the other developer. N=6

Graduate and undergraduate students

Librarian administration

Library technologists

Non-librarian reference staff and student employees

Primarily library IT and the library's Learning Spaces Program staff (librarians and technology staff)

We worked with a School of Business professor who had received a technology grant to purchase one 3-D printer and supplies. The grant was an internal, university-sponsored technology grant.

31. Please indicate which library staff are/will be responsible for the management of fabrication services and maintenance of equipment and/or software. Check all that apply. N=33

Staff Category	Management of services	Maintenance of equipment	Maintenance of software	N
Individual hired for this purpose	4	5	4	8
Individual who also has other responsibilities	20	18	17	22
A team of individuals	16	17	16	22
Other individual	0	1	1	1

Staff Category	Management of services	Maintenance of equipment	Maintenance of software	N
Other group	2	1	1	2
Total Responses	33	32	29	33

If you selected "Other individual" above, please specify the individual and briefly describe their responsibilities. N=1

Maintenance contracts: MLIS student doing a two-year residency.

If you selected "Other group" above, please specify the group and briefly describe their responsibilities. N=2

Not yet determined.

Office of Information Technology in collaboration with School of Industrial Design

Additional Comments N=3

Media Commons is a service provided by the campus central IT organization and is partnered with the library on providing services within the library Knowledge Commons. The Media Commons is staffed by multimedia specialists who provide curricular training on video and audio creation. The 3-D printing/makerspace will be developed and staffed by Media Commons in partnership with the library.

One Multimedia Specialist who has worked in the New Media Center for 14 years has primary responsibility for these services. He provides the majority of the training and maintenance, and he supervises the work of 5 student employees who have been trained to use the 3-D printer and support some reference services. The department head does presentations and outreach.

We would look to hire a new position to run the day-to-day operations, but overall support would be a team of people.

32. Please enter the number of library staff who support fabrication/makerspace services. N=29

Number of staff

Minimum	Maximum	Mean	Median	Std Dev
1	10	3.52	3.00	2.11

Staff	N
1	3
1.2	1
2	7
3	6
4	5
5	1
6	4
7	1
10	1

33. Please enter the position titles of up to three of the library staff who support fabrication/ makerspace services and estimate the percentage of time they spend on these services. N=27

Position title 1:	%	Position title 2:	%	Position title 3:	%
Academic Technology Support Technician		Librarian and Coordinator of Digital Scholarship Service Development		Post-doc Fellows	
All 4 positions total to about 0.5 FTE at the Library Information Associate level					
Associate Dean of the Graduate School	10%	Lab Assistant	50%	Library Specialist	10%
Commons Manager/Librarian	Varies, maybe 10–20%	Student Tech	Varies, maybe 10–30%	TBD	
Consultant, Digital Media	10%	Digital Media and Network Coordinator	15%	Digital Media Mentors	75%
Digital Fabrication Specialist	100%	Lab Manager	20%		
Digital Scholarship Librarian	15%	Associate University Librarian	5%	Programmer	10%
Digital Scholarship Services Librarian	50%	Design Architect	50%	Developer	30%
Digital Science Librarian	35%	Emerging Technologies Coordinator	25%		
Emerging Technology Services Librarian	80%	University Library Technician	50%	University Library Technician	20%
Entrepreneurship Librarian	25%	Copy Center Manager	10%	Make @ State Coordinator	100%
Faculty Liaison & Instruction Librarian	10%	Manager, MADLab	15%	Graduate Student Library Assistant	85%
Head, Library Systems	5%	Info Tech Specialist III	5%		
Library Assistant	10%	Operations Manager	5%		
Library Media Specialist	20%				
Manager of the Fordham Commons	15%	Unit Computing Specialist	5%	Art Librarian	20%
Media Support Technician	75%	Head of Circulation	50%	Graduate Research Assistant	50%
Multimedia Resources Center Manager	10%	Library assistant	10%	Programmer/Analyst	5%

Position title 1:	%	Position title 2:	%	Position title 3:	%
Multimedia Specialist	50%	Student Multimedia Assistant(s)	25% of one FTE (10 hours weekly total across 5 students' time)	Head, New Media Center	5%
Science Librarian	80%	University Library Technician	25%	Graduate Student Assistant (2)	100% (35 hours/ week)
Science Librarian	15%	L3 Library Tech	25%		
Science Librarian	20%				
Science Librarian	5%				
Science Reference Supervisor and Software Instruction Manager		Library IT Manager		Assistant Library IT Manager	
Student Multimedia Studio Manager	50%	Student workers	75%		
Technology Services Supervisor	10%	Technology Services Manager	5%		
Technology/Media Specialist	TBD	Emerging Technologies Librarian	TBD		

34. Does your library have a board of directors or advisors for fabrication/makerspace services? N=37

Yes	1	3%
Not yet, but we plan to	4	11%
No	24	65%
Not yet determined	9	22%

If yes or you plan to, please briefly describe the membership, their number, and their primary responsibilities. N=3

Right now we seek input on an informal basis, but as we create a dedicated makerspace area, we would like to have a group of students and faculty who are focused on improving services and outreach.

We are part of a campus consortium of makerspaces and provide support and feedback to one another.

Would like a Board of Advisers with a small number of individuals who could advise on industry trends and new educational opportunities.

Additional Comments N=2

But we do have a Friends of the Library Board, Student Advisory Board, and University Library Committee who are all very interested in the space and will give support and suggestions from time-to-time.

Nothing official, but we actively engage our users to help with strategic decisions.

BUDGET AND FUNDING

35. Is there (or will there be) a separate budget allocation for fabrication/makerspace services or is financial support part of the general library budget? N=33

Part of the general budget	25	78%
Separate budget	7	22%

Comments N=6

Besides the initial technology grant ($6,000), all the support for the makerspace is library-funded.

For the existing production service, the budget is hybrid between general budget (full-time staff effort) and service receipts pay for the student assistants, supplies, and equipment. For the new makerspace, the library paid for the construction and furniture, but a $25,000 grant and $25,000 donation are paying for the fabrication equipment. We received a $5,000 grant to pay for electronic consumables and will charge users for filament and other materials.

Hybrid model. Staff on general, consumables in separate

It is self-supporting (pays for itself). Initial investment came out of the general fund, though it has been paid back.

Research budget allocation was $10,000 for the year.

Separate budget of $11,000.

36. What items does/will the budget cover? Check all that apply. N=34

Equipment/Hardware	30	88%
Materials	29	85%
Software	24	71%
Peripherals	19	56%
Staff	16	47%
Specialized furniture	13	38%
Staff training	9	27%
Other item	1	3%

Please specify the other item. N=1

Equipment maintenance

37. **Which budget item is/will be the single largest expense?** N=31

3-D printers

Equipment/hardware (5 responses)

Equipment initially, possibly staff salary ongoing

Equipment. If we decide to take 3-D modeling training in order to provide workshops to our users, this might end up being more than the equipment.

Filament; however, we have not yet developed an equipment refresh plan.

Likely software

Likely to be equipment/hardware initially (3 responses)

Materials (2 responses)

Materials are easily the largest expense, second only to staffing.

Not sure at this point, probably the equipment.

Not sure if staffing or supplies will cost more when 3-D printers are made available.

Not yet determined.

Staff (7 responses)

Staff (ongoing), equipment

Staffing is first, but equipment/hardware is second.

Student staffing

The renovation and furniture are the biggest costs.

The servicing and materials, over the long run, end up costing more than the machine.

38. **What are/will be the most significant sources of funding for fabrication/makerspace services in your library? Check all that apply.** N=35

Internal library regular budget	19	54%
Internal library temporary or special project budget	14	40%
Usage fee	11	31%
Donations	11	31%
External grant funding	7	20%
Additional budget from parent institution	6	17%
Member fee	0	—
Class/Workshop fee	0	—
Other source of funds	4	11%

Please specify the other source of funds. N=4

Budget transfer from current service providers

Endowment monies

Unknown!

Unspecified currently, but likely the regular budget.

39. **Which source of funding is/will be the single largest source?** N=27

A temporary special budget at first to buy the equipment and then usage fees to pay back the cost.

Additional budget from parent institution.

As of now, the library budget. We hope to find outside/additional funding sources in the future.

Donations

I think it must be the regular budget? I don't really know.

Internal library regular budget (8 responses)

Not sure at this point.

Not yet determined (3 responses)

One-time funding for the renovation of space which included fixed and movable furniture and safety items such as ventilation snorkels and air scrubbers.

School of Mechanical Engineering and School of Industrial Design

The internal library regular budget will be the biggest source of funding into the future. We have received some money from the university for selected start-up costs.

Usage fee (3 responses)

Usage fee: we will cover all ongoing costs.

User-generated revenue will be our primary source of funding for operations, but we are working on larger grants to help expand capabilities and capacity on campus.

We are currently using a technology fund from an endowment but are seeking a donor for a makerspace.

We hope a donor. :)

SERVICE ASSESSMENT

40. **Has your library assessed or evaluated the performance of your fabrication/makerspace services, for example by collecting usage data, interviewing individuals or focus groups, surveying users, etc.?** N=38

Yes	15	40%
Not yet, but we plan to	10	26%
No, and we have no plan to do so	2	5%
We are not yet at the assessment stage	11	29%

If you answered that you do not have plans to assess services or you are not at the assessment stage, you will skip to a question on service gaps.

SERVICE ASSESSMENT METHODS

41. What assessment method(s) does/will your library use? Check all that apply. N=24

Collect and analyze data on use	22	92%
Observations	20	83%
User satisfaction survey	14	58%
Interviews with individuals	10	42%
Interviews with focus group	7	29%
Other assessment method	5	21%

Please briefly describe the other assessment method. N=5

Assessment is built into our plans. We don't have it open yet.

Log data

Talking with patrons as they come to get items printed.

This is in early planning stages and not fully fleshed out.

We have our users fill out a log book on their print jobs. We also hand out an evaluation form after each safety training session.

42. Of the assessment methods already used, which has been most useful for evaluating these services? N=16

Assessment is planned. Services are not yet active.

Collect and analyze data on use (6 responses)

Collection and analysis of data; Observations

Comments from both interviews and observations

Interviews with Individuals

Observations

Obtaining a detailed usage log of our full service has been incredibly helpful. We are investigating methods to track use of our walk-up, DIY service, but are finding it incredibly difficult due to the self-serve process.

Talking with patrons as they come to get items printed.

Training session evaluations let us know what people wish we did (offer design workshops, supervise the job for them); the people who answered the survey have primarily used the service so they are satisfied with the service model restrictions.

Use data, particularly providing demographics of all of the disciplines actively using this service.

We collect from users information on projects they create and how the Libraries helped them accomplish these.

43. Has any assessment of your library fabrication/makerspace services led to changing services, programs, or specific uses of the makerspace? N=20

Yes	11	55%
No	9	45%

If yes, please briefly describe what changed. N=11

Assessment of the service frequently leads to changes in our service offerings. Often these are subtle adjustments to pricing, outreach, and training, but the data also identifies new needs on campus and who we may be able to partner with for larger fund raising efforts.

Assessment supported the need for additional training/workshops for patrons.

Future equipment needs. Guiding future development of workshops and outreach.

It informed the library on which departments on campus to do more outreach and engagement with.

There's a clear need from our students for design training. We're working on offering that to our certified users for fall 2015.

Used in planning for expansion of services. Training session topics are more diversified. More hands-on use of equipment.

We assessed how students used the space by talking to them and we found out that the students prefer to do things themselves. So we do the initial training and they can use the equipment by themselves and if they need any help they can request it.

We decided to circulate objects printed on our 3-D printer based on a suggestion.

We have altered the focus and timing of the workshops based on user feedback.

We have revised our policies based on usage statistics and purchased a second 3-D printer to support the increase in demand for course-related prints.

We used to think that all files with non-manifolds were the fault of our patrons, but we found out that those files that wouldn't print on our machine were working fine on other's machines. This led us to take the blame more fairly for failed prints.

SERVICE ASSESSMENT: USAGE DATA

44. If you gather (or plan to gather) data on the use of fabrication/makerspace services, please indicate the type of data. Check all that apply. N=24

Number of service users	22	92%
Number of total 3-D prints	21	88%
Number of class/workshop registrations	18	75%
Number of class/workshop attendants	18	75%
Number of reference requests	14	58%

Number of website visits	13	54%
Number of participants at user outreach events	12	50%
Number of total 3-D scans	12	50%
Number of consultations	12	50%
Retention of models developed or printed	6	25%
Other data	7	29%

Please specify the other assessment data. N=7

Costs, revenue, and comparison with competition

How often particular software is used.

Log book has information about each print job.

Money spent on filament and other supplies.

Number of curricular applications as reported by users.

Print jobs broken down by type (personal projects vs. research oriented jobs), department of user, university status (undergrad, grad, staff, faculty)

Type of service user (which department, status of user)

45. Which type(s) of data has been most useful for evaluating these services? N=16

# of total prints

Assessment is planned. Service not yet offered.

Data on print jobs and workshop evaluation forms

Demographic data

Number and type of prints; number of reference/project planning requests

Number and type of service user (which department, status of user)

Number of 3-D prints

Number of service users (3 responses)

Number of service users, number of workshop attendees

Number of service users and engagement with our users (consultations, workshops, etc.) have proved to be helpful in identifying areas of improvement and evaluating the services' effectiveness. We also found that actively going to local maker events identifies who is not using our services and gives us an opportunity to understand why.

Number of total prints, curricular demand

The number of 3-D prints and workshop attendees

Type of 3-D printing (what type of machine used)

Unknown, too early

46. If you gather data on the number of service users, please give your best estimate of the number of the users for the current fiscal year. N=18

Minimum	Maximum	Mean	Median	Std Dev
15	1970	485.39	179.00	620.00

47. During what period of the year is your makerspace the busiest? N=18

Assessment is planned. Service not yet offered.

Beginning of each semester

During mid-terms and finals week

Early part of the semester

End of the semesters (November and April). Then number of users next year will increase dramatically with the new workshop focused Makerspace.

Fall (October–November)

Fall and Winter terms: midpoint of term is the busiest

Last month of the semester(s)

March–May

Near end of each term

November/December

Our services are near capacity so we do not see much fluctuation in utilization throughout the year, however, emphasis and urgency changes. For example, common deadlines for students (mid-terms, finals) translate into different submissions than the summer, which are typically more research oriented.

Spring and fall semesters

Three weeks before finals

Too soon to tell right now, but seems like it corresponds to class project due dates.

Towards the end of the semester as students are finishing up projects.

We are not sure yet.

We do not know yet.

We've only been around since October 2014. It's been steady since then.

SERVICE ASSESSMENT: INTERVIEWS AND SURVEYS

48. If you have interviewed or surveyed users, what aspects of makerspaces and fabrication technologies are of the greatest interest to them? N=11

3-D printing

Access and speed of services is very important. Pricing is also very important.

Access to the 3-D printing technology, knowing how a 3-D printer works, the 3-D printed object itself, 3-D modeling for design

Arduinos; 3-D printing

Assessment is planned. Service not yet offered.

How to do it, how much it costs and how long it will take to print the item and to complete the print job.

How to use the 3-D printer and 3-D scanner

Learning how to create 3-D models in different types of free software.

Our previous surveys showed growing maturity with technology and growing need to gain access to new capabilities (higher resolutions, new material types, etc.)

We have primarily interviewed individuals to learn more about how they are incorporating 3-D printing into their course work.

We haven't formally interviewed or surveyed users.

49. If your library has conducted a user satisfaction survey, please indicate the level of perceived satisfaction of the users of these services using a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied. N=5

1 Very Dissatisfied	0	—
2	0	—
Neutral	2	40%
4	1	20%
5 Very Satisfied	2	40%

Comments N=2

Our overall satisfaction score was a 3.5/4.

Satisfied with initial classes. Service itself not evaluated.

SERVICE GAPS

50. Overall, what are the most significant gaps in your current library services in this area? N=25

A wider variety of printing. Ability to submit print jobs remotely. The existing makerspace is a production service where users pay for the jobs (printed and laser cut objects). The new makerspace offers a DIY environment for hands-on experiences and workshops.

Currently, these services are not offered.

Currently we are seeing a fragmentation of our user base. There are, and will be, students who are matched to our low-cost, walk-up 3-D printers as they currently exist. However, after a short period of time these individuals mature and begin seeking more capabilities and capacity within the same DIY model. The challenge is in providing multiple tiers of resources and then training with them. We are instituting a badging track that will provide the foundation for this, but have yet to identify the equipment that would be the best fit for such an open environment.

Currently, we have a single printer for the pilot. We have no means to expand without funding, and so the campus community has no open place for rapid fabrication.

Design workshops, 3-D modeling and design

Dissoluble supports, large build volume, variable print materials (currently only offer PLA)

Keeping up with the demand for 3-D printing (equipment capacity) and for hands-on workshops (staffing capacity)

Librarian training in very complex 3-D modeling designs

Need to define this as a core service and staff and situate it (physically) accordingly.

Not a service gap, per se, but our services could be more integrated into coursework and/or research. We have had some uptake by instructors and faculty research advisors, but that is an area that we will continue to foster.

Not having a broader variety of maker tools, like robotics and laser cutting.

Our pilot service is in limbo. We need a technology upgrade.

Our users don't currently have personal, hands-on access to the tools and we don't have a dedicated space open to the community. Our printing and scanning is mediated by staff in a staff area.

Overnight access

Providing a cohesive, strategic set of equipment and services. Right now we are just piloting a 3-D printing program.

Reference model, expert consultation

Space for training and demonstrations

Staff support, self-service machines

Staffing

We are short on staff and the staff working with the makerspace have too many other responsibilities.

We currently offer no services in this area.

We have no service in place yet. The gap on campus is that there are makerspaces that are open to all users, but situated in faculties in a way that presents a barrier to outside users.

We need more coverage for more hours.

We offer a 3-D lab with numerous 3-D software applications, but currently do not offer 3-D printing or 3-D scanning.

We would like to supplement 3-D printing with 3-D scanning because many students do not have design skills. We may also explore higher-end model printers.

REWARDS AND CHALLENGES

51. Please briefly describe up to three rewards of providing rapid fabrication/makerspace services.
N=33

Anticipate filling a user need. Increased library engagement with users.

Attracts students to the library for things they never knew we did. Inspires staff and engages them in creative processes. Creates spillover effects into our other work: prototyping, etc.

Brings users into the library for other purposes than quiet study. Moving library services into the science research process.

Contributions to campus teaching and research. Participate in the end-to-end knowledge creation process. Develop informatics tools that can assist design learning.

Engage with users in different way. Staff appreciate ability to learn new skills.

Engaged students. Active library use. Providing access to services not available elsewhere in area.

Expand role of library, inspire students, help with student success, and support campus mission. Another service libraries can provide as the field evolves to help keep us relevant. Opportunity for staff (including library staff), faculty, and students to create.

Forging new connections to curriculum, research, and individual projects and students. Providing a new and needed service. Staff learning and employing new skills.

Fun. Accessible: seeing technology at work. Making your own project.

Getting undergrads interested in the library. Expanding our services. Keeping the university on the cutting edge of technology.

Giving students exposure to technology that they may not otherwise have access to. Developing new partnerships built around making and the maker culture. Increasing library engagement with students and community.

Interaction with entire campus, all schools. Forming a university-wide maker network to share expertise, equipment, training opportunities. Unveiling new methods to interrogate research questions.

It encourages patrons from several different departments to come to the library. Offers all students in all departments the use of this exciting technology. Allows for outreach and engagement of the library and its services to campus and the community.

Learning practice. Building community. Interdisciplinary learning.

Level the playing field for social science and humanities students and faculty members who don't have as much access to these services as those in STEM fields. Broaden scope of services provided by the library.

Opportunity for more collaborations and partnerships with campus colleagues. Profile on campus raised significantly. Engagement with researchers and other staff who are using the services which are now readily available and accessible.

Partnership with campus partners. Cool factor.

Provide general access to hard-to-find technology. Expand the role of the Libraries in supporting learning. Expand the opportunity of students to play with new technology.

Provide low-barrier access to a useful service. Provide instruction to a cross-campus, interdisciplinary audience. Support the curriculum.

Provide students, campus community a place to explore and utilize this technology. Increased collaboration with campus partners. High visibility, good press.

Provides hands on experience to all disciplines.

Providing access to services that enable innovative student projects that otherwise would not be completed. Exposing students to new technologies that they wouldn't see elsewhere. Introducing new pedagogical methods for faculty to use to teach.

Providing open access to maker technologies for our campus. (Don't have to be an Art student or enrolled in a particular class). Increased student engagement. Creating an innovative learning environment.

Rapid iteration of the design process. Applied, action-based learning. Smiles.

Researchers quickly get the tools or products they need. Students get to show off their design skill. It engages students such that they learn new skills.

Strong engagement with individual users. Broad interdisciplinary demand and potential. Stimulates innovation.

Student engagement! We get to speak to so many students and researchers doing fun and interesting things. We get to see them experiment and learn on the spot and share their ideas in our fun and easy-going environment. Collaboration! A wonderful project for me to collaborate on with my partner in the MADLab. Since we've started our safety training sessions, he's started doing more instruction in the lab on mobile app development. Mentoring and teaching! The project has been very rewarding for our GSLA to see how a service gets set up, managed, promoted, and evaluated. It has been very rewarding for me to mentor her on service development and have her work really be meaningful to this project.

Support faculty. Support students. Support scholarship.

The look of awe on users' faces the first time they see a 3-D printer in action. Being able to offer an emerging technology that would otherwise not be available to most of our users. Partnering with units on campus with whom we had not previously collaborated.

Unanticipated and novel use of technology. Student reaction and excitement. Opens up opportunities for new partnerships and relationships.

University saves money by having it centralized in the library instead of several around campus. The library is neutral ground. It has brought engineers into the library, which used to be difficult to do.

Using the service as an example to market the library to potential donors and other groups on campus. Giving non-technical students the opportunity to experiment.

Yet to be fully determined.

52. Please briefly describe up to three challenges of providing rapid fabrication/makerspace services.
N=34

Access for users. Gatekeeping on content. Building understanding among faculty.

Availability of staff/time expertise.

Controlling unrealistic turnaround expectations. Appropriately pricing 3-D print services. The future landscape of university 3-D printing services is unknown.

Cost to build and support. Technical and logistical (training, reservations, access, workflows, maintenance). Ownership & collaboration: who's in charge and how will they share?

Cost, expertise, and promotion. Technical issues/support problems including budgeting time when requests come all at once (student deadlines). Determining what to print re: ethics and campus policy.

Defining the library's role in design learning and digital scholarship. Providing adequate and useful support for digital scholarship. Getting the buy-in of teaching departments and faculty.

Equipment breaks down frequently. Users have too high of expectations of what 3-D printing can actually do. Requires a lot of training and upkeep.

Equipment doesn't always work as expected. Users need to learn what things the space/tools can and cannot do. Keeping up with the most current technology.

Fit a new service into an already tightly allocated budget. Developing staff skills and partnership needed to make it succeed.

Funding. Staffing. Time for outreach.

Funding (start up). Expertise for staffing. Maintenance.

Getting buy-in from faculty and students without a dedicated assignment requiring 3-D printing or other making. Double scheduling prints that take longer than estimated. Providing a sustainable service that also allows staff to maintain a reasonable workload.

I would love it if we could have people use the 3-D printer set-it-and-forget-it style. Because our service isn't really supervised, the users have to stay in the MADlab while their job is printing. This is extremely time consuming. I wish our printers could print faster... Handling the certification lists and reservations takes a considerable amount of time spent filing and sending confirmation emails. Would be nice to automate more of this process.

Keeping equipment updated. Promoting use. Determining printing policies.

Lack of staff time. Hardware malfunctions. Lack of funds to buy newer hardware models.

Limited funding. Ensuring needed expertise. Service sustainability.

Limited resources. Not widespread in use. Barrier of entry due to specialized skills needed.

Machine reliability. Tracking use in an open environment. Managing user expectations.

Maintaining currency/relevance as technology evolves. Determining scope of services, where the line is between library and departmental/specialized services.

Maintaining equipment to keep it operational. High cost of some machines and materials. Can be difficult to retrofit a traditional library space into a space supporting fabrication.

Maintaining hardware. Time commitment. Staffing.

Managing student expectations about what we can offer. Software licensing and installation. Campus culture of fear around new technologies and their safety.

Managing the services without dedicated staffing. Maintenance of equipment. Keeping on top of latest tech developments.

Money (for staff and supplies). Clarity of mission / justifying services as part of library services.

Providing adequate support.

Several aspects of the services have a steep learning curve. Labour-intensive: need to be onsite to work with users. Experience some dismissiveness of the services, e.g., "gimmick" or "fad".

Staffing. Space.

Staffing the makerspace. Keeping up with the demand.

Technology can be unreliable. 3-D printing is a slow technology that can lead to bottlenecks at busy times. Patron-designed files can have errors so they are unable to print correctly without repair/redesign.

The staff time needed to adequately support the service. The display space needed to showcase the objects. The funding required for a new "non-traditional" service.

The technology itself is tempermental. Providing staff support.

The time commitment. Keeping student staff trained. Keeping up with demand.

Time consuming. Troubleshooting problems can be difficult since this is newer technology. This sector is rapidly changing so it was difficult to determine what technology to purchase.

Yet to be fully determined.

FUTURE CASTING

53. Please briefly describe what you envision as the role of rapid fabrication and makerspace services in the future of research libraries. N=42

A central department-free place on campus for this technology is key, since the applications are so broad. Many individual researchers might lack the funding or expertise to utilize the equipment. Having a library service solves this problem and opens up the technology to the entire community.

As a catalyst for innovation.

As a component of scholarly communication, e.g., the visual display of quantitative data can now be 3-D.

As the technology becomes cheaper, service providers will move into higher-end printing as more people have access to cheaper 3-D printing. Service providers will also likely provide for printing of other types of materials not available in cheaper printers such as nylon, metals, and soluble support materials.

Assisting in the development and creation of critical making projects and bringing tangible and 3-D work into areas of research where it both has existed and traditionally may not have been possible previously.

At a basic level, libraries can provide the resources for experimentation and creative uses of materials. For example, the director of our Art Library has some interest in how 3-D printing could be used by studio art students.

At the university schools and departments proactively provided these services. Therefore the Libraries facilitates the individual schools and programs when needed.

Brings people together. A place to put technical skills into practice.

Given typical tight budget environments and space limitations across most universities today, it is important that academic libraries considering any services in the future will need to connect those services to the particular academic needs of the campus. Without doing that, any new service will not be successful. So, an assessment of need, applicability, and redundancy on campus is essential and will be highly individualized by campus. As an example, a well-appointed makerspace is less than a block from the library on campus. Other questions related to makerspaces relate to who would maintain the equipment (the library or IT (or other unit)); would libraries find themselves called upon to archive the products of these services; would there be internal uses for the technology (spare parts for obsolete technology in library); would this makerspace also include low-tech tools such as hammers, measuring tape, hand-tools

as libraries are already familiar with the storage and loan of items; what level of expertise would library staff need to provide this service and potentially train users.

I see the role of rapid fabrication and makerspace services in the future of research libraries as something that is needed and will be required by the students for them to succeed in their academic work.

I think teaching critical making and design skills will be more important than the access to the technology, esp. as the printers get cheaper and easier to use. I feel a lot of pressure to include 3-D design in our workshops. I think this will also be important for getting non-engineering students using the technology and seeing a need for the technology as part of their academic research and student experience.

I think the library can play several key roles in supporting digital scholarship and design learning. The primary campus fabrication and makerspace facilities will, for the most part, not be in academic libraries. Rather, academic libraries will offer collaboration and meeting spaces for students and faculty, information and literature review services, design software and hardware, visualization and data analysis tools, and overall project planning and support and services.

It has a future but should not be a major focus into the future since the technology will become more integrated into early education and people's lives.

It will continue to grow.

It will potentially have a similar role that "regular" printers and scanners currently have in research libraries.

Libraries are idea spaces, and makerspace technologies foster creativity and give research options to all disciplines rather than just those in the sciences, engineering, or architecture. I hope that libraries move away from 3-D printing as a Kinkos-like service, and toward conceptualizing fabrication as a tool to investigate, interrogate, and learn by doing.

Libraries are more and more about user-generated content, whatever the content type. We are platforms of discovery, empowerment, and growth. Makerspaces will be crucial to viability of research libraries, as our ways of acquiring knowledge are shifting to include hands-on technical and design creation. Integrated approaches to knowledge are crucial if research libraries want to survive.

Libraries have always served as community hubs for participatory and collaborative learning, providing shared resources that promote personal growth, learning, and exploration. Over the last two years, libraries have become a space to house, develop, and promote the maker movement, which is a growing community of individuals and groups who devote their time to designing and building rather than just consuming. The maker movement shares the library's devotion to the exploration of ideas and the development of skills and knowledge using shared resources and expertise, but with a more visible emphasis on creativity and hands-on learning. The trend in developing digital media resources within libraries and offering related programming is currently on the rise in academic libraries as universities recognize how shared access to and training in emerging technologies can benefit learners. By providing resources that are accessible to the entire university community and pairing those resources with the expertise of information professionals, academic libraries are well positioned to support maker activities, many of which allow students to develop the 21st century literacies, like digital and spatial literacy, that are vital to student retention and success, post-graduate career development, and lifelong learning. We will see makerspaces in academic libraries moving from a trend to a core service.

Makerspaces and fab labs are the next steps in active learning and in presenting scholarship. Makerspaces allow student learners to engage in learning by doing and hold the potential of a new form of scholarly communication. From videotapes to CD-ROMs to Internet access to color printing, libraries have always embraced new technology quickly in order to provide open and equal access, and makerspace is the next in line.

Makerspaces and rapid fabrication will continue to be an important part of future research libraries. Research libraries are open to everyone on campus and often in the community. Individuals can use library services regardless of what department they are a part of or what their affiliation is. Before, only certain departments or labs were allowed to use these types of resources. Makerspaces allow for new technologies to receive widespread dissemination and allow for a central location where people can learn about them, use them, and discover new uses. More libraries will make these technologies part of their everyday services and continue to teach and train patrons.

Makerspaces facilitate a different type of information literacy, and rapid protoyping extends the information lifecycle into the physical. Libraries can provide expert consulting, literacy building, collections development, and data management for this important new set of tools.

Manifestation of ideas!

Offering these services to all of the campus, not just students in programs where it's an inherent part, e.g., engineering. Connecting making to theory and critical inquiry.

Partnerships and collaborations will continue to increase, with equitable access to all disciplines and faculties. Provision of a common ground in support of interdisiplinarity. Support of research even at the undergraduate level: provides a critical skill at the entry level. Natural fit for libraries to participate in moving from digital to physical to digital forms of scholarship.

Provide services in a space that serves all campus users with the possibility of serendipitous interdisciplinary collaboration. Open for a large number of hours with staff able to help people. This provides greater ROI for the university for expensive equipment that is often inaccessible in departmental offices. As the needs of students and faculty changes, we will adopt new services as appropriate.

Providing a space, technology, and services that allow users to experiment and learn through experience despite their discipline and ability.

Rapid fabrication and makerspace services will be important to many, if not most, research universities. However, the location of these services will vary. Right now, these services are provided to a small segment of our students and faculty within specific departments. I don't know whether that will change.

Rapid fabrication and makerspaces seem a relevant future service that students, faculty, and staff at universities will want. Libraries, as they seek to define their future, could be very good places to provide makerspaces, as we have facilities, technologies, and other services with which makerspaces would seem to fit well, given appropriate staff training. However, it would be a new business for us, and only time will tell whether it is a desired and useful service.

Research libraries may provide research assistance for fabricators; however, the tools, equipment, and expertise are better provided by academic departments.

Research libraries that have an active multimedia design lab, such as the Student Multimedia Design Center, see a role for rapid fabrication and makerspace services that are centrally available to all users, particularly as a demonstration site, and for wide application for basic student needs.

Since the libraries support the scholarly resource needs of the entire university community, we envision including rapid fabrication services in the libraries' faculty lab, which is currently under discussion.

The 3-D printing service is useful for making quick prototypes; it's great to allow users to experiment. I envision it becoming more of a service than a research interaction with libraries purchasing more high-end equipment as the hardware becomes less expensive for the average consumer.

The library is the perfect home for such services provided they have the infrastructure to support it and invested partners on campus. I see a continued evolution of capabilities and a reduction in costs for 80% of user's needs. The remaining 20% will require highly specialized equipment that may not be appropriate for a general campus resource. (i.e., why would the library get an MRI machine…) As machines mature and become more reliable, there needs to be a shift towards content generation. This need is particularly strong in areas that currently do not embrace making as part of their academic and scholarly culture.

This is one of many new services to open the libraries to a new way of thinking regarding information access and creation in a public space. It's a first step in a much larger collection of services for users in the future.

This will continue to grow well into the future. Libraries will likely have more of a role with collecting and describing 3-D objects and helping connect researchers to each other.

University libraries serve departments across campus and are the perfect place to showcase emerging technologies, from 3-D printers to virtual reality goggles like the Oculus Rift. Our faculty and students need to be exposed to the latest and greatest technologies to be inspired and spark ideas about how all the disciplines can take advantage of creative resources and innovations. Libraries should not only provide access to resources for research purposes but also for production of new knowledge. Engineers and architects aren't the only people who can use 3-D printing, rapid fabrication, and makerspace services. Putting creative tools into the hands of all our faculty and students should be one of the primary goals of today's libraries. We'll be amazed at the outcomes these smart, savvy students can create when provided with the resources.

We are currently in discussions with our Science and Engineering faculties regarding renovations of our libraries located within their buildings. The Faculty of Science is interested in creating some makerspace, which could be located in the library. It is most likely that if we were to be engaged in delivering makerspace services, it would be in collaboration with one or both of these faculties.

We believe this is an incredibly important service for the campus, but not one that is limited to or the sole responsibility of research libraries. While these services are being offered by other campus departments, we will continue to serve as liaison to these services for our users, and keep abreast of the demands of these services. Should additional service points be prudent, we will certainly consider adding additional capacity for this service. We are observing that the areas of physical reproductions for visual studies, art history, and visualization of data analysis are quickly growing, as well as physical representations of models in the biological/life sciences and engineering. At this time, the demand in these areas are being fulfilled by makerspace services within or near the departments that offers these disciplines.

We expect the need for and use of this type of service to continue to increase; service supports the growing pedagogical practice of hands-on learning.

We have found the library has been very successful in building a campus (and regional) community for making activities. This includes identifying and partnering with other spaces on campus that offer rapid fabrication/makerspace services. The library is partnering with the Communication, Rhetoric, and Digital Media department by supporting one graduate assistantship who will be imbedded in the library to develop workshops and research/instructional opportunities for faculty on campus. There are several faculty members who have modified their curriculum to include our services in student learning, research, and assignments. The existing makerspace has supported several senior design projects, some of which were turned into entrepreneurial opportunities for the participants.

We have struggled with this for seven years. We believe there is a role, same as there is a role for 3-D software and 3-D visualization and fabrication labs in research libraries. We have had a 3-D lab at this library for eight years. 3-D software is heavily used by patrons. We have discovered that 3-D printing is increasingly desired by many of the patrons we serve for research, pedagogy, class assignments and projects, etc. We see 3-D visualization and fabrication as a key aspect

of emerging information representation and application or applied information and library sciences and the associated mission and services of research libraries.

We most likely will be a satellite location for other programs actively using the technology.

ADDITIONAL COMMENTS

54. Please enter any additional information that may assist others in understanding your library's experience managing rapid fabrication technologies and/or makerspaces, or what you would tell other libraries preparing to offer such services. N=23

3-D printers are not a turnkey device; they require "care and feeding."

Although we are pushing for a large-scale service, we have plans for implementing much smaller services as well. There is a fear that any small-scale service would get overwhelmed and be very difficult for already-busy staff to manage. In addition, we believe that a small-scale service would discourage faculty from incorporating 3-D printing into their curricula, as we would not be able to guarantee access to such a limited resource. Regardless, we hope that we move forward and, at the very least, demonstrate the need for a large-scale service.

As part of a library renovation project, we hope to investigate the possibility of creating a makerspace or augmenting an existing capability in the Digital Media Center (which is not part of the library). Our investigation will be based on current capabilities within the Digital Media Center and within the Maryland Institute College of Art (MICA).

Based on our experience in providing makerspace services since September 2014: don't be afraid to experiment with workshop topics; don't have to operationalize at the outset; don't feel compelled to fulfill all aspects of such services; work within the context of your library; be prepared to be informed by your users; enable them and push the experimental aspects.

Be aware of what departments, schools, and programs are doing in order to understand needs and existing services.

Be inclusive, not exclusive!

Get involved, take some risks. The expense, initially, need not be huge and yet it can have impact.

Have a clear outreach strategy. Have fun showing off what your awesome printer can do!

It is a popular service but many users want projects printed that are for personal use (valentine's gifts) or are too large and time consuming for our equipment and staff.

It is definitely worth trying. Don't get too hung up on the details and start small to see if there is demand in your local community.

It is not like inkjet or laser printers in that it requires someone tech savvy just to operate it. These require frequent troubleshooting and maintenance. The time commitment involved is huge.

Make sure you have staff that like working on these types of services and are interested in keeping up with technology changes.

Marketing new services like 3-D printing is very important. You can't simply buy a 3-D printer and expect people to flock to you. Setting up demonstrations around campus and writing articles for the campus newspaper can help get the word out. Our student employees have become very adept at using software programs like Tinkercad and have been able to assist with managing the print queue from patrons. Having a dedicated staff member assigned to get this service off the ground has been essential, though.

Please note that this survey combines responses from librarians who are engaged with both 1) a small-scale makerspace service in a branch library and 2) a planned, larger-scale makerspace service within the Digital Scholarship Center (to be opened this summer).

So far we have not been convinced that the cost of ownership of this technology is within our means to support.

Such services require a strong understanding of your environment and potential user base since the technology, training, and support requirements can vary greatly depending on those factors. Due to our service exceeding 10 years in age, we had the privilege of growing with interest on campus, This allowed us to pivot and adjust relatively quickly due to the deep expertise in-house.

The library is seriously considering 3-D printing as a service. This is not high-priority because 3-D printers and other fabrication labs are already available on campus.

The NCSU Libraries is the primary academic library participating in an IMLS National Leadership Grant on Makerspaces lead by the Children's Museum of Pittsburgh as a collaborative campaign to promote the establishment of makerspaces throughout US libraries and museums.

The UT Foundry (aka Creativity Commons). The University of Texas Libraries in collaboration with the College of Fine Arts is developing the UT Foundry, a Creativity Commons that will be located at the Fine Arts Library (FAL). The UT Creativity Commons will be a makerspace that will have a visual and performing arts focus while integrating engineering and computer science elements, resulting in a STEAM (Science, Technology, Engineering, Arts, and Mathematics) teaching and learning center. The University of Texas at Austin is one of the largest public universities in the United States yet the campus community does not have open access to a makerspace. The UT Foundry project will fill this gap and provide this much needed space and service. It will be open to all students, staff, and faculty at the University of Texas at Austin. The intention is to support non-curricular and curricular projects simultaneously. For example, both the layperson who walks in and wants to create a high-quality sound recording for a personal project and a professor who is developing a classroom assignment around printing a 3-D object will have equal access to the staff expertise and technology. The "creative class" is thriving in Austin, Texas from maker meet ups to the gaming and app development private sector to a community of non-professional musicians and more. Learning happens outside the classroom as well as inside-and teaching is being done by librarians, IT specialists, and fellow students, as well as faculty. The UT Foundry will be a center for arts learning, facilitating exploration. For example, students have interests that they want to develop, but they may not be studying the subject in the classroom. Faculty may be moving into new areas of teaching but need access to tools and expertise to develop an idea. An individual may have set a personal goal and needs the tools to accomplish it. The UT Foundry will play a role in these cited examples. The UT Foundry will include a Game Development Studio, a Recording Studio, a Video Production Studio, a 3-D Print Workspace, a Maker Workshop and a Digital Media Lab. Equipment and devices will be available to check out. Project activities will include training teaching and supporting patrons on effectively using the technology, developing programming and organized activities based on stakeholders input, and outreach. The goal for the project is to have a robust facility and service that is fully utilized by the university community. Desired outcomes for the user include acquisition of new skill sets or refining a fledgling skill, as well as progress or completion of projects. Not only will this initiative develop space and services central to arts teaching and learning, there are two other major outcomes: the development and diversification of information professionals, and the building of community in the DIY and maker movements on the UT campus. The UT Foundry is designed to have an impact on immediate learning, experience, and quality of life, as well as long-term transferrable skills and lifelong learning. Compare the creative experience to a physical experience at the gym. The gym experience not only improves long-term health, but immediate health as well. Similarly, the UT Foundry will have an immediate impact on a person's mind, encouraging creativity while a skill set will be acquired that can be used outside the space. The patron of the UT Foundry will be able to learn new software, hardware, and technology to assist them in realizing their own project goals. The University of Texas Libraries has put several pieces of this initiative in place during the 2014/2015 academic

year. 1. A device library has been established. Devices available for check out include cameras, tablets, microcontrollers, superdrives, keyboards, motion and gesture controllers, etc. 2. Funding has been secured for the recording studio component through the Hornraiser crowdfunding initiative. As of this report, $15,695 has been raised. 3. A Media Technician position has been approved and will be recruited over the summer. This will be a support and training position. 4. The UT Libraries is considering the addition of an Arts and Creative Technologies Librarian to provide the vision, outreach, and programming for the UT Foundry. 5. A Graduate Research Assistant position will be transferred from another area within the Fine Arts Library to support the work of the UT Foundry. 6. A project assessment plan has been developed so that we will be able to solicit feedback and fine tune this important new initiative To completely build out the UT Foundry, approximately $300,000 is needed for facilities upgrades, improvements, and equipment purchases. For more information see: http://news.utexas.edu/2015/02/02/beyond-textbooks-high-tech-tools-help-students-build http://blogs.lib.utexas.edu/texlibris/tag/creativity-commons/

This survey is limited in scope and language, given its focus on fabrication and makerspace functions. Academic libraries will be involved at a higher level, I think, in digital scholarship and design learning activities. Libraries should be involved in all aspects of the end-to-end knowledge creation process. I see a number of ARL libraries offering collaboration spaces and equipment, visualization walls and services, data analysis tools, data management support, and design technology software and equipment, including 3-D printing and scanning.

Utilize your students. Some of them have a deep interest in building and making, and they will be invaluable in figuring out what settings, filaments, code, etc. works, and what doesn't. Do not expect to start a makerspace without at least one person who enjoys taking equipment apart, fixing it, and putting it back together. The printers especially, even though they purport to be consumer-ready, do require a DIY ethos, and manufacturer support can be sparse.

We are actively involved in gathering information and becoming more aware of the services on campus, and growing demand for them. We are also involved in investigating the appropriate policies necessary for responsible use of these services, and learning more about how other departments that currently host these services set policies at their sites.

We offer a user-mediated service-- this means that anyone who wants to use our printer (and has a library card) must become certified (attend safety training, sign a waiver, pass a knowledge test). Then they book time on the printer during our open hours and then they print their object in a relatively unsupervised, secure space. We DO NOT supervise the printer, offer consultations on design (although we do help with the makerbot desktop software part), or print the object for people. Right now our service is focusing on teaching people how to use the printers (makerbot replicator 2) safety and effectively.

RESPONDING INSTITUTIONS

University at Albany, SUNY
University of Alberta
University of Arizona
Boston University
Brigham Young University
University of British Columbia
University at Buffalo, SUNY
University of Calgary
University of California, Irvine
University of California, Los Angeles
University of California, San Diego
University of Colorado at Boulder
Colorado State University
Columbia University
University of Connecticut
University of Delaware
Duke University
Florida State University
Georgetown University
Georgia Institute of Technology
University of Hawaii at Manoa
University of Illinois at Chicago
University of Illinois at Urbana-Champaign
University of Iowa
Iowa State University
Johns Hopkins University
University of Kansas
Kent State University
University of Kentucky
Library of Congress
University of Louisville
McMaster University
University of Manitoba
University of Maryland
Massachusetts Institute of Technology
University of Michigan
Michigan State University
University of New Mexico
New York University
University of North Carolina at Chapel Hill
North Carolina State University
Northwestern University
Ohio University
Oklahoma State University
University of Oregon
Pennsylvania State University
Purdue University
Queen's University
Rutgers University
Smithsonian Institution
University of Southern California
Southern Illinois University Carbondale
Syracuse University
Temple University
University of Texas at Austin
Texas Tech University
University of Toronto
Vanderbilt University
University of Virginia
Virginia Tech
Washington State University
Washington University in St. Louis
University of Wisconsin–Madison
York University

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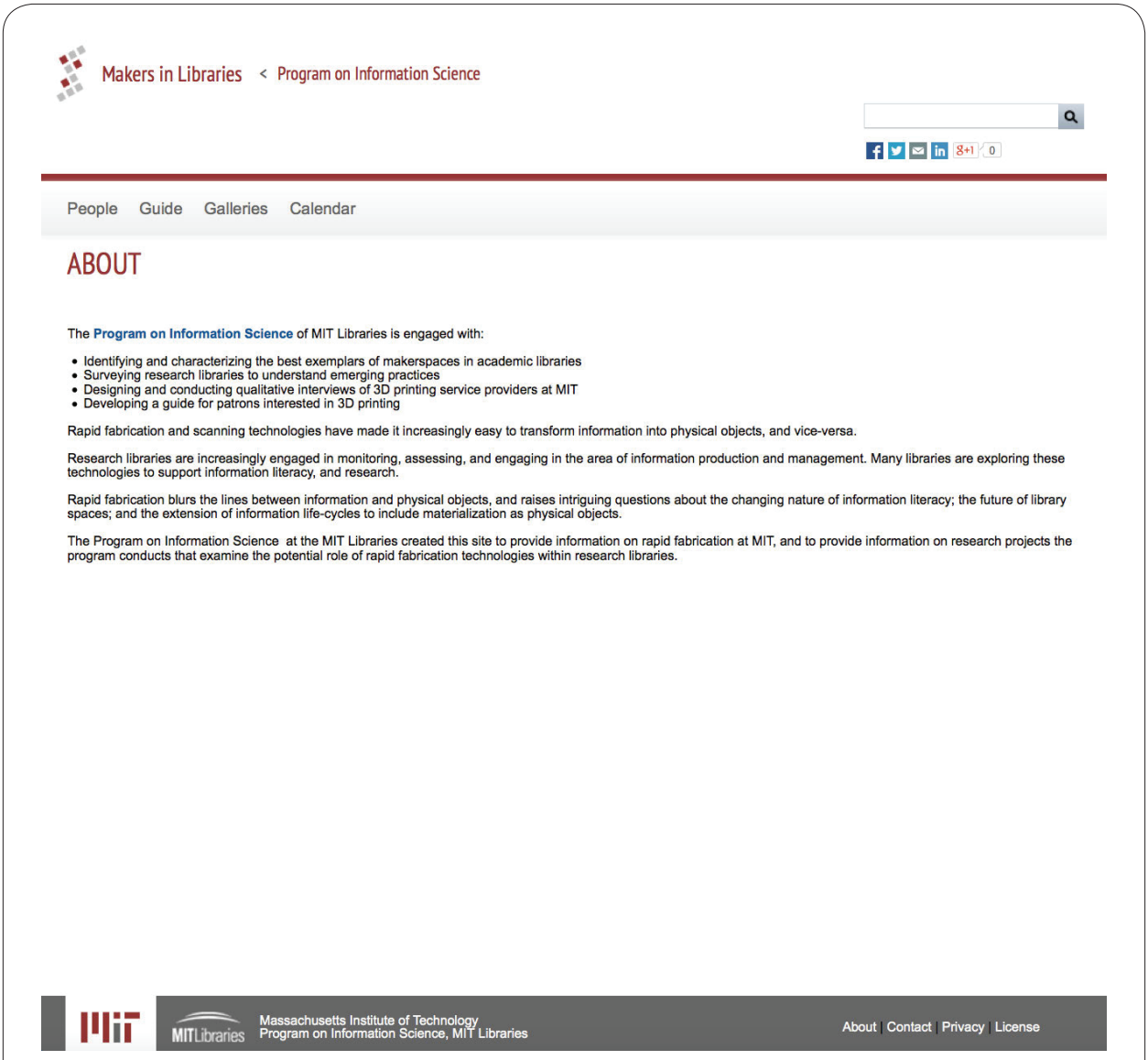
REPRESENTATIVE DOCUMENTS

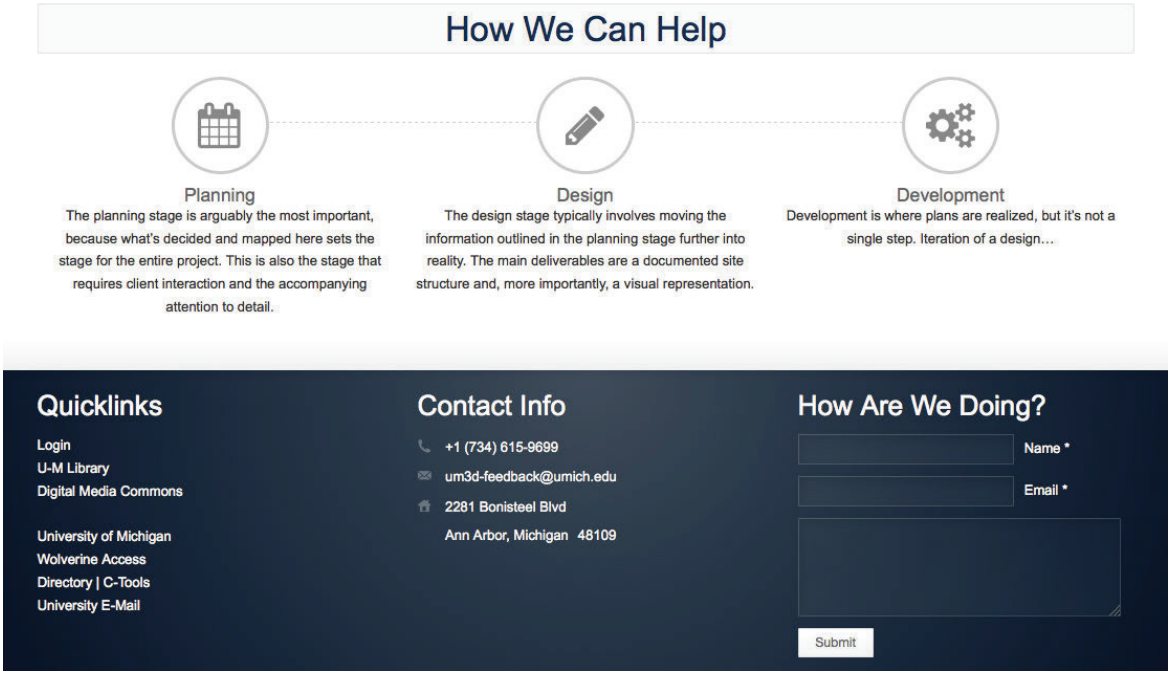
Makerspaces

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Makers in Libraries | About
http://projects.informatics.mit.edu/maker/about

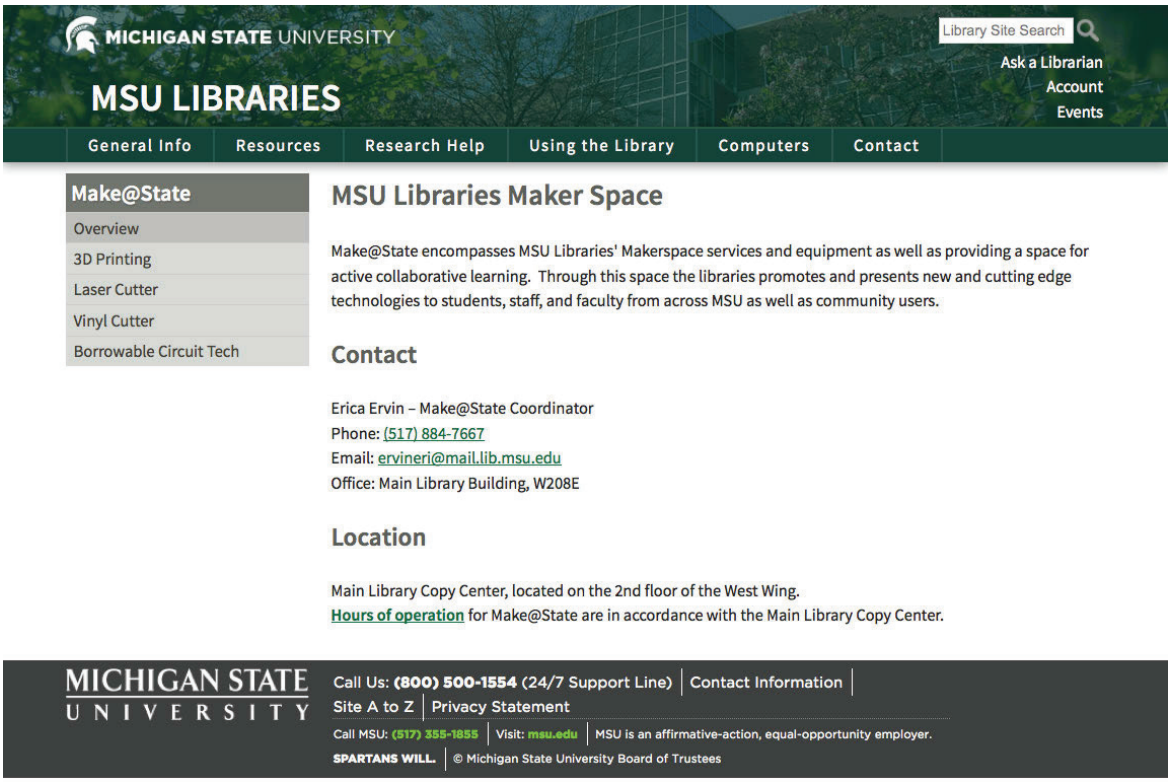


UNIVERSITY OF MICHIGAN
UM3D Lab
http://um3d.dc.umich.edu/

UNIVERSITY OF MICHIGAN
UM3D Lab
http://um3d.dc.umich.edu/



MICHIGAN STATE UNIVERSITY
Make@State
https://www.lib.msu.edu/makeatstate/



UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Makerspace
http://library.unc.edu/makerspace/

NORTH CAROLINA STATE UNIVERSITY
Makerspace
http://www.lib.ncsu.edu/services/makerspace

UNIVERSITY OF VIRGINIA
Scholars' Lab | Makerspace
http://scholarslab.org/makerspace/

SCHOLARS' LAB

about research fellowships makerspace events blog people

Makerspace

The Scholars' Lab Makerspace is a place for tinkering and experimentation with technologies like desktop fabrication, physical computing, and augmented reality. Open to everyone, we specialize in applications and research questions in the humanities and arts.

Informed by a rich tradition of Library support for exploring materiality in Special Collections and the new Fine Arts Library Materials Collection, and for participating in the physical-made-digital in both the Scholars' Lab and the Digital Media Lab in Clemons, our Makerspace staff can help faculty and student researchers evaluate new approaches to their work, and consider both the hows and the whys of making.

Learning *how* to do something with humanities technology gives us a more informed perspective on *why* we do things in the humanities. **Both are vital.**

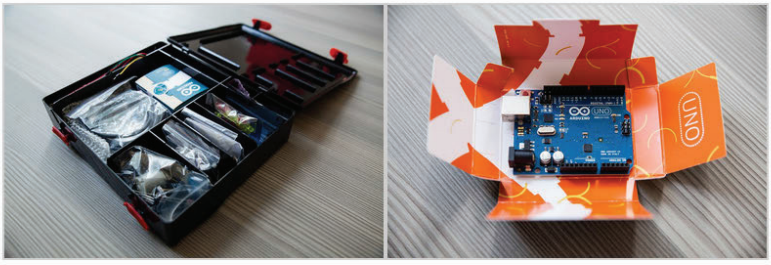
UNIVERSITY OF VIRGINIA
Scholars' Lab | Makerspace
http://scholarslab.org/makerspace/

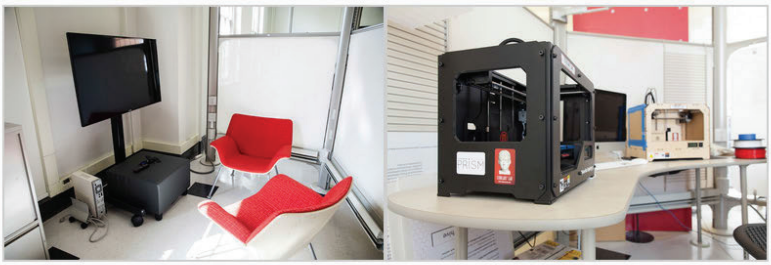
SCHOLARS' LAB

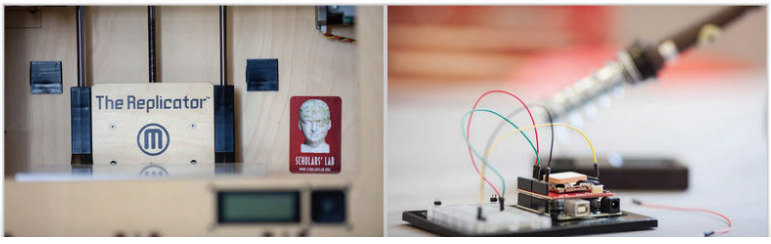
about research fellowships makerspace events blog people

Using the Makerspace

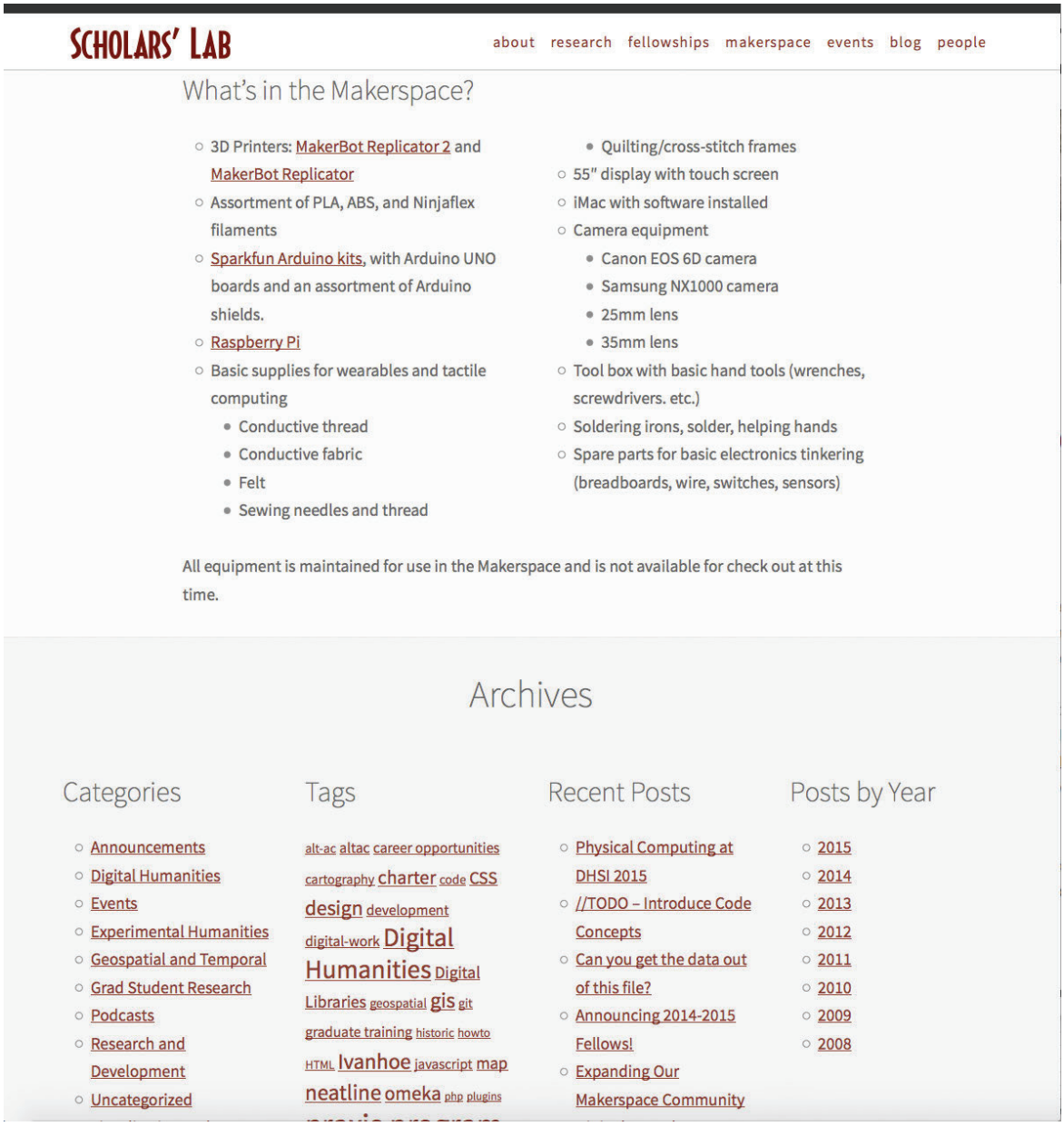
Interested in exploring the Makerspace? Have an idea to use microcontrollers or 3D modeling and printing technology to enhance your research or differently interrogate your assumptions? **The Makerspace is open from 1:00-5:00 p.m. Monday through Friday**. Stop by to talk to one of our student consultants, attend our maker workshops, or contact us at scholarslab@virginia.edu to schedule an appointment with Scholars' Lab faculty and staff to discuss your planned project.







UNIVERSITY OF VIRGINIA
Scholars' Lab | Makerspace
http://scholarslab.org/makerspace/



SCHOLARS' LAB

about research fellowships makerspace events blog people

What's in the Makerspace?

- 3D Printers: MakerBot Replicator 2 and MakerBot Replicator
- Assortment of PLA, ABS, and Ninjaflex filaments
- Sparkfun Arduino kits, with Arduino UNO boards and an assortment of Arduino shields.
- Raspberry Pi
- Basic supplies for wearables and tactile computing
  - Conductive thread
  - Conductive fabric
  - Felt
  - Sewing needles and thread
  - Quilting/cross-stitch frames
- 55" display with touch screen
- iMac with software installed
- Camera equipment
  - Canon EOS 6D camera
  - Samsung NX1000 camera
  - 25mm lens
  - 35mm lens
- Tool box with basic hand tools (wrenches, screwdrivers. etc.)
- Soldering irons, solder, helping hands
- Spare parts for basic electronics tinkering (breadboards, wire, switches, sensors)

All equipment is maintained for use in the Makerspace and is not available for check out at this time.

Archives

Categories

- Announcements
- Digital Humanities
- Events
- Experimental Humanities
- Geospatial and Temporal
- Grad Student Research
- Podcasts
- Research and Development
- Uncategorized

Tags

alt-ac altac career opportunities cartography charter code CSS design development digital-work Digital Humanities Digital Libraries geospatial gis git graduate training historic howto HTML Ivanhoe javascript map neatline omeka php plugins

Recent Posts

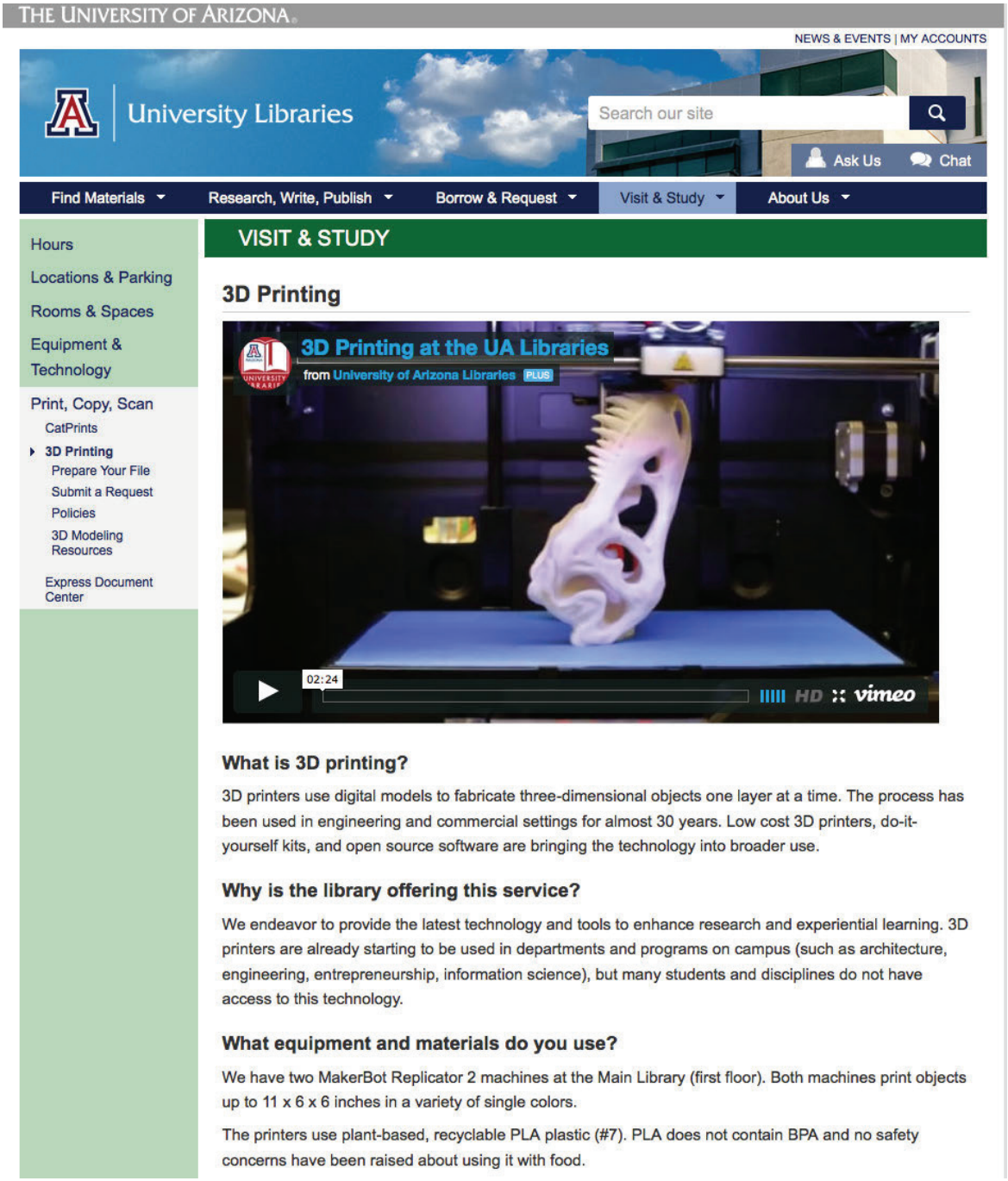
- Physical Computing at DHSI 2015
- //TODO – Introduce Code Concepts
- Can you get the data out of this file?
- Announcing 2014-2015 Fellows!
- Expanding Our Makerspace Community

Posts by Year

- 2015
- 2014
- 2013
- 2012
- 2011
- 2010
- 2009
- 2008

3D Printing Guides

UNIVERSITY OF ARIZONA
3D Printing
http://www.library.arizona.edu/services/print/3D



UNIVERSITY OF ARIZONA
3D Printing
http://www.library.arizona.edu/services/print/3D

Who can use this service?

Priority is for UA students, faculty, and staff. Non UA-affiliates may submit requests, but may be backlogged during peak use during the semester.

What does it cost?

Cost is $0.10 per gram of filament. Total cost is determined once your order is complete.

Charges are added to your library account and must be paid before pick up. Non UA-Affiliates pay at the Express Document Center.

What is the turnaround time?

Printing times vary based on size, complexity, and any backlog. Once you submit your request, we will contact you within two business days with an approximate turnaround time.

How do I submit a request?

1. Get your 3D model ready
2. Save the model as .stl file (maximum size 50 MB)
3. Submit your 3D printing request

Where can I get help?

Visit our 3D Modeling Resources for modeling software, design libraries, and tutorials.

Consultants from the Office of Student Computing Resources are available in the Multimedia Zone (Main Library, first floor) to answer software questions.

Contact Us

(520) 621-6442
3D@lib.arizona.edu

Last modified: April 9, 2015

University Libraries

1510 E. University Blvd.
Tucson, AZ 85721
(520) 621-6442
Contact us

Support the Libraries ♥

Main Library
Science-Engineering Library
Fine Arts Library
Arizona Health Sciences Library
Special Collections
The University of Arizona Press

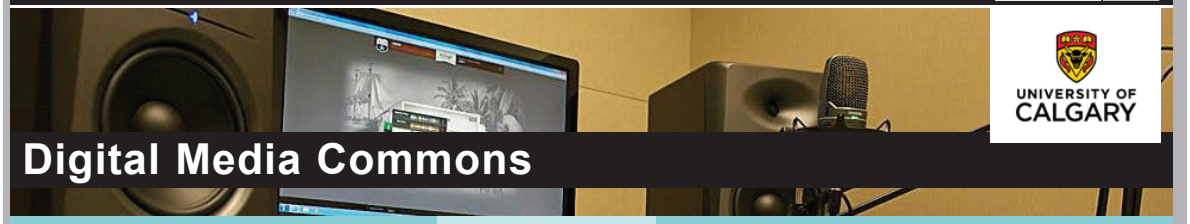
Information for:
Undergraduate students
Graduate students
Online & distance students
Faculty
Instructors

Policies Accessibility Jobs

Staff sign in

BRIGHAM YOUNG UNIVERSITY
3D Printing Guide: Home
http://guides.lib.byu.edu/3Dprinting

UNIVERSITY OF CALGARY
Digital Media Commons | 3D Printer
http://library.ucalgary.ca/dmc/3d-printer



UNIVERSITY OF CALGARY

Digital Media Commons

3D Printer

What is 3D printing?

A 3D printer works by depositing a substance layer by layer until an object is formed. The printer in the Taylor Family Digital Library (TFDL) is a consumer-level machine, meaning that it creates small-scale objects using a plastic-based material. The process is much cheaper and less messy compared to that of large, industrial 3D printers.

Why offer a 3D printing service?

Libraries and Cultural Resources (LCR) is committed to providing the latest technology and tools that enhance research and hands-on, experiential learning. LCR is providing a valuable service to students and researchers by making 3D printing more accessible. Many experts believe this technology will revolutionize the world of manufacturing.

The consumer-level printer in the TFDL is ideal for experimenting with design and prototyping. It allows students and researchers to test their concepts in a real-world scenario.

Where is the 3D printer located?

The printer is located in the Digital Media Commons on the third floor of the Taylor Family Digital Library.

How do 3D printers affect air quality?

Unlike larger, industrial printers that use resins, our consumer-level 3D printer does not emit fumes. The material used in the printer in the TFDL is a synthetic substance called polylactic acid (PLA). It is derived from plant material and is biodegradable.

How much detail can the printer create?

The 3D printer in the TFDL is capable of producing objects with a resolution of one-tenth of a millimetre, approximately the width of a strand of hair.

Request 3D print job

How much does it cost to print an object and how long does it take?

It costs $1.00 plus 15 cents per gram for a printed item, which could amount to a few dollars. It can take anywhere from a few minutes to a several hours. Cost and time depends upon the size and complexity of the object.

What kind of objects can I print?

You can print anything on a small scale, such as a prototype design, an action figure or a trinket for a necklace.

There are many open-source files available online that can be downloaded for printing, or you can create your own.

Please keep in mind that you can't print everything you find online. Copyright laws and intellectual property rules apply. Ensure that any files you acquire from the internet are open-source or that licensing requirements are met. There are many websites that have Printable 3D models available for free or for sale:

- Thingiverse
- 3D File Market
- Open Education Database
- Dalhousie University Library 3D Model Repository

The Digital Media Commons also has a variety of 3D modeling tools available so that you can create whatever object that you can imagine:

- Rhino 3D
- Autodesk 3DS Max

Autodesk AutoCAD
- SketchUp Pro
- Blender

There are also basic modelling applications available online that can help you get started with CAD and nonCAD 3D modelling:

- Tinkercad
- OpenScad
- SketchUp
- PhotoToMesh

Can I see my object being printed?

You can watch the 3D printer in action anytime during regular business hours. Due to the large number of projects, it is extremely difficult to pinpoint exactly when your project will be printed.

How do I request a print job?

Once you submit your request, it will be added to the queue and staff will notify you when your item is ready for pick-up.

3D Printing Directions

The file must be in .STL, or stereolithographic file format to print it. MeshLab is a freeware program that can be used to view and convert your file to STL format.

Once a request is submitted you can keep in touch with the 3D Printing department through the confirmation email that will be sent to youThe maximum build size is 284 x 154 x 152 millimeters, or 11.2 x 6.1 x 6 inches.

When notified by email that your model is ready you will be sent an invoice listing the print cost. Take this receipt to the TFDL Service Desk to make your payment and collect your model.

How can I learn more about the 3D printing service?

Sign up for an orientation session by visiting the workshop calendar.

UNIVERSITY OF CALIFORNIA, IRVINE
3D Printing Pilot Service
http://www.lib.uci.edu/services/3D-printing/

HOME | ABOUT US | SERVICES | RESEARCH TOOLS | COLLECTIONS | HOW DO I

ASK A LIBRARIAN!
Ask ANTswers (BETA) Interactive FAQ

SEARCH Go

Services

- Course Reserves
- Borrow
- Interlibrary Loan
- Computing
- Printing & Copying
- For Users with Disabilities
- Scholarly Communication and Management Program
- Digital Scholarship Service

Quick Links

- Hours
- Event Calendar
- Connect from off-campus
- Course Reserves
- Borrowing
- Interlibrary Loan
- My ANTPAC
- Study Space Locator

- Langson Library
- Ayala Science Library
- Grunigen Medical Library
- Libraries Gateway Study Center
- Law Library

- Supporters & Friends

3D Printing Pilot Service

Explore, Make, Fabricate

3D printing has changed the landscape of fabrication. From engineers to artists, entrepreneurs to hobbyists, 3D printing makes it easy to turn an idea into reality. The UCI Libraries have purchased a 3D printer to support such creativity. Located in the Multimedia Resources Center in the Ayala Science Library the 3D printer is available to UCI faculty, students, and staff. During this pilot period while we assess the demand and resources required to provide such a service, printing will be free.

Who can print?

The 3D printer is available for use by all UCI students, faculty, and staff on a first-come first-served basis.

What can I print?

The 3D printer must be used exclusively for lawful, non-commercial purposes and in compliance with all University of California policies. Users may not collect, upload, transmit, display, create or distribute content that violates or may violate any law or third-party right, including, without limitation, any copyright, trademark, patent, trade secret, moral right, privacy right, right of publicity, or any other intellectual property or proprietary right. The UCI Libraries reserve the right to decline any print request for any reason.

What 3D printer does UCI Libraries own?

UC Irvine Libraries has a Makerbot Replicator Desktop 3D printer. This 3D printer uses 1.75 mm polylactic acid (PLA) filament.

- Build Volume: 25.2 L x 19.9 W x 15.0 H cm [9.9 x 7.8 x 5.9 in] or 7,522 cubic centimeters [456 cubic inches]
- Include photos of objects with dimensions here

Additional specifications and information about the Makerbot Replicator can be found at http://store.makerbot.com/replicator.

Where is the 3D printer?

The 3D printer is in the Multimedia Resources Center in the Ayala Science Library.

How much does it cost?

During this assessment period 3D printing is free.

How do I design my object?

Designing a 3D object to print is done using 3D modeling software. There are many 3D modeling programs available, including professional programs like SolidWorks and Autodesk Inventor (which are available in the MRC), and free software programs like Blender, Wings3D, FreeCAD, and Sketchup. You will need export your 3D model into .STL (STereoLithography) format in order to print it.

How do I print my object?

Users must bring their design to the MRC during business hours. The print object must be an .STL file on a USB flash drive formatted in any format (preferably ntfs, or fat32). All submissions are subject to approval based on scheduling and availability of the 3D printer.

What colors can I print in?

Your printed object will be printed in one solid color. Available colors vary. You will be given your choices when you submit your request.

What if I have more than one object?

Each file must be submitted separately by filling out a separate 3D Printing Request Form available at the MRC.

How long will my object take to be printed?

The time it takes to print an object can vary widely. See our time guidelines for estimates. Using the UCI Libaries' 3D printer may take up to a week depending on the queue. For more time efficient options, check out these alternate providers. If you have more than one object and there is high demand for the 3D printer, the Libraries may choose to schedule only one printed object per person/entity per day.

How will I know when my printed object is done?

You will receive an email from the UCI Libraries and can pick up your printed object from the MRC during normal business hours. Printed objects will be held for 3 business days.

Can I watch my object print?

coming soon

Why does my printed object look unfinished?

Users may see imperfections in their printed objects. Small bumps or holes and rough edges at the base of an object may occur with 3D printing. Imperfections can be cleaned up with fine sand paper, file and/or tools. The Makerbot Replicator is very accurate but there may be some instances where objects do not fit precisely together. Objects are built from the ground up and in certain instances prints will require support material and / or rafts to ensure proper printing. Support materials is often needed if the design has large overhangs or parts suspended in mid-air. Rafts are often used as support at the base of the model. Users may receive their print job with the tape still on. These types of are easily removable by the user. Staff will not be responsible for removing materials and / or rafts. All finishing must be done by the user outside of the Libraries' buildings. See our tips for finishing a printed object.

Is there somewhere else I can print my object?

Check out these alternate providers.

How can I find out more about the 3D Printing Service Pilot?

If you have more questions about 3D printing email libmrc@uci.edu or visit the MRC during business hours.

Back Top of Page

3D Printing @ Columbia

Upload a 3D Model | Categories | PrinterCam | Timelapse | Printed | Sort by | Featured

Introduction

Tips for Designers

3D models can be designed in any number of software programs, including:

- 123D Design – free
- 3DS Max @ DSC
- AutoCAD @ DSC
- blender – free
- FreeCAD – free
- Maya @ DSC
- MeshLab – free
- OpenSCAD – free
- Rhino3D
- SketchUp – free
- SolidWorks
- Thingiverse Customizer – free
- Tinkercad – free version
- ZBrush

Models submitted below must be submitted in .stl format. Most software programs can export 3D models in .stl format, but get in touch if you need help.

Tips on 3D printing

The Libraries recently purchased a MakerBot Replicator 2 as an experiment to engage users in a number of software programs already provided by the Libraries (AutoCAD, 3DS Max, Maya, etc.). If use of the Replicator 2 is high, we hope to expand our offerings in this 3D ecosystem in the future.Before an .stl file can be printed on the MakerBot Replicator 2, it must be converted from .stl into G-code using the free Makerware software.

To properly print, 3D models must be closed forms, meaning that there are no improper openings in the data file. You can check to see if your model is closed at willit3dprint.com.

Looking for other places to print?

GSAPP students can have models fabricated in the Digital Output Shop (3D printing info).
A number of laboratories in SEAS have 3D printing facilities.
Vendors such as Shapeways will print models for a fee.

Submit your design to be printed

Ready to have your model printed? Now you can upload an .stl file, pick a view that best represents the model, and fill out some brief information. Then we'll print the most up-voted models from time to time!

We will evaluate designs that are submitted to ensure they are printable, appropriate, and will not consume an unreasonable amount of our limited resources.

Frequently Asked Questions

1. How much does it cost to print on the Libraries' 3D printer?

Right now there is no cost to print something in 3D, but we also do not guarantee that everything that is submitted will be printed.

2. I need to have something printed by tomorrow – can you do it?

The Libraries' 3D printer is not intended to be like one found in a fabrication shop. We encourage you to get in touch early in the design process if you would like to have

something printed. Items submitted via the submission interface will likely not be printed immediately following approval for the site.

3. How will you choose what items to print?

Periodically the staff of the Science & Engineering Library will print some of the most up-voted models, so be sure to share your models with your friends so they can vote for them!

Printing will ultimately be at the discretion of the staff in the Science & Engineering Library; items that will be used for research, teaching, classwork, or other stated missions of the University and the Libraries will, however, be favored over items that are for personal use.

4. What are the specs of the MakerBot Replicator 2? How big can it print? What's the resolution?

All of the specifications for the MakerBot Replicator 2 are listed on the product feature list.

Questions? Comments?

Get in touch via email or online!

Leave a Reply

Your email address will not be published. Required fields are marked *

Name

Email

Website

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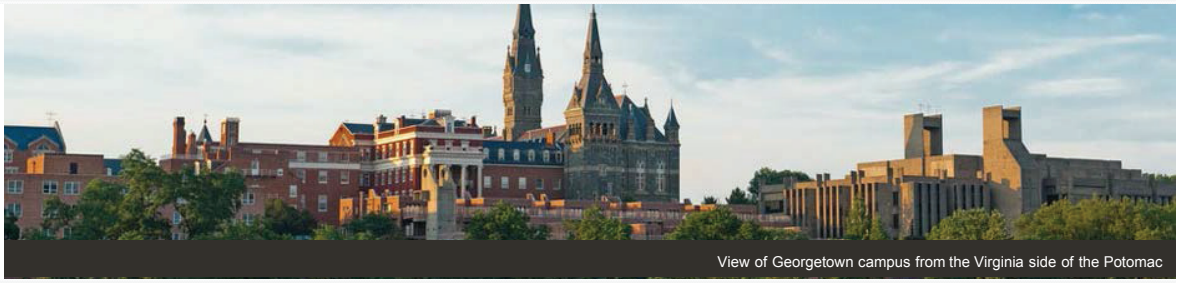


View of Georgetown campus from the Virginia side of the Potomac

3D Printing/Scanning at Georgetown University Libraries: PRE-PRODUCTION & PLANNING

3D Printing/Scanning at Georgetown University Libraries

WHAT IS 3D PRINTING?

3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the entire object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.

(From http://3dprinting.com/what-is-3d-printing/)

HOW DOES IT WORK?

It all starts with making a virtual design of the object you want to create. This virtual design is made in a CAD (Computer Aided Design) file using a 3D modeling program (for the creation of a totally new object) ór with the use of a 3D scanner (to copy an existing object). This scanner makes a 3D digital copy of an object and puts it into a 3D modeling program.

To prepare the digital file created in a 3D modeling program for printing, the software slices the final model into hundreds or thousands of horizontal layers. When this prepared file is uploaded in the 3D printer, the printer creates the object layer by layer. The 3D printer reads every slice (or 2D image) and proceeds to create the object blending each layer together with no sign of the layering visible, resulting in one three dimensional object.

(From http://3dprinting.com/what-is-3d-printing/#howitworks)

WHAT MATERIALS ARE AVAILABLE?

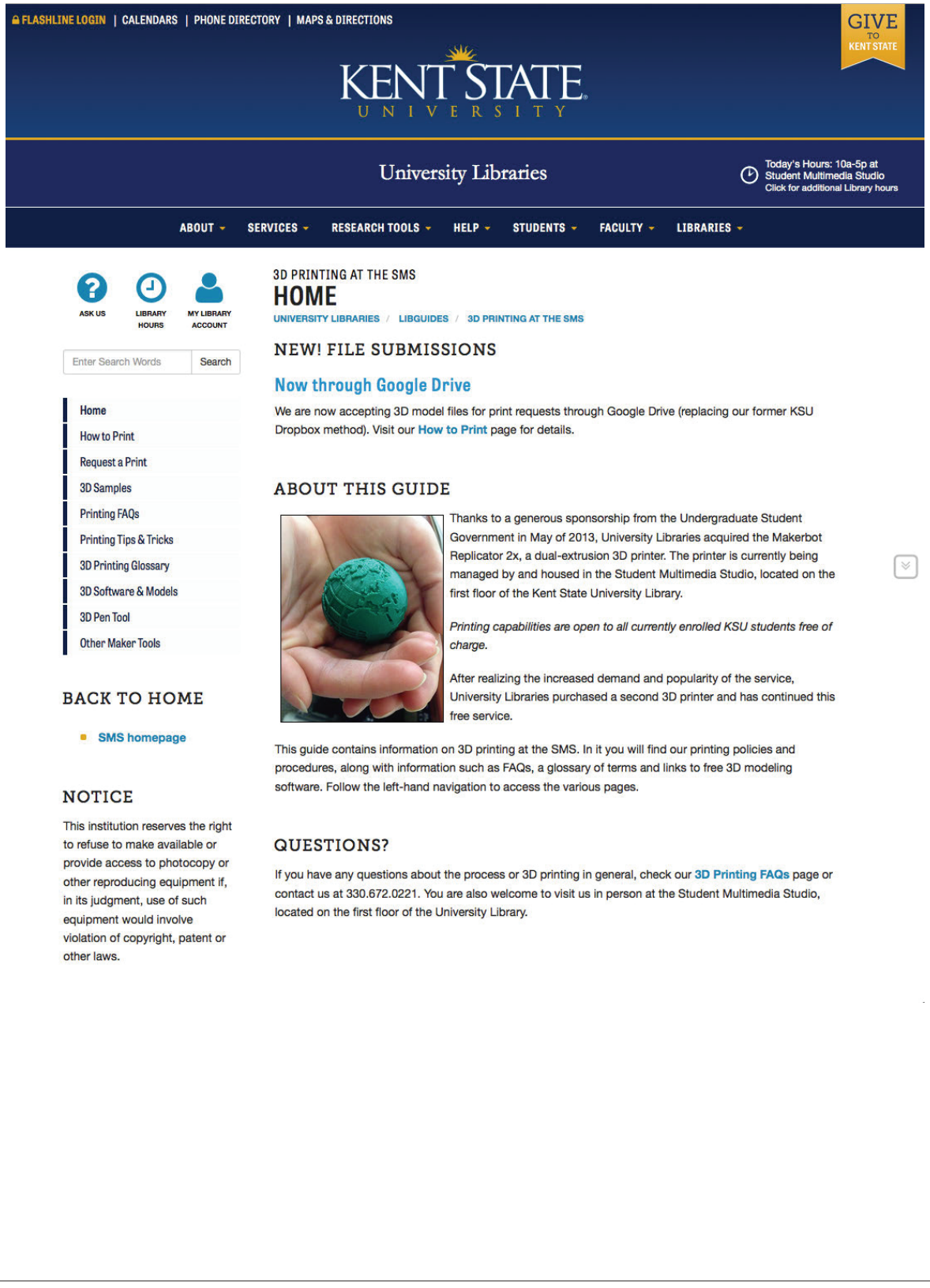
MakerBot PLA Filament is a nontoxic resin made of sugar derived from field corn and has a semisweet smell (like waffles) when heated. It is the best and most consistent PLA filament for your MakerBot Replicator 3D Printer and guaranteed to have no heavy metals, phthalates, or BPA.

(From https://store.makerbot.com/pla-filament)

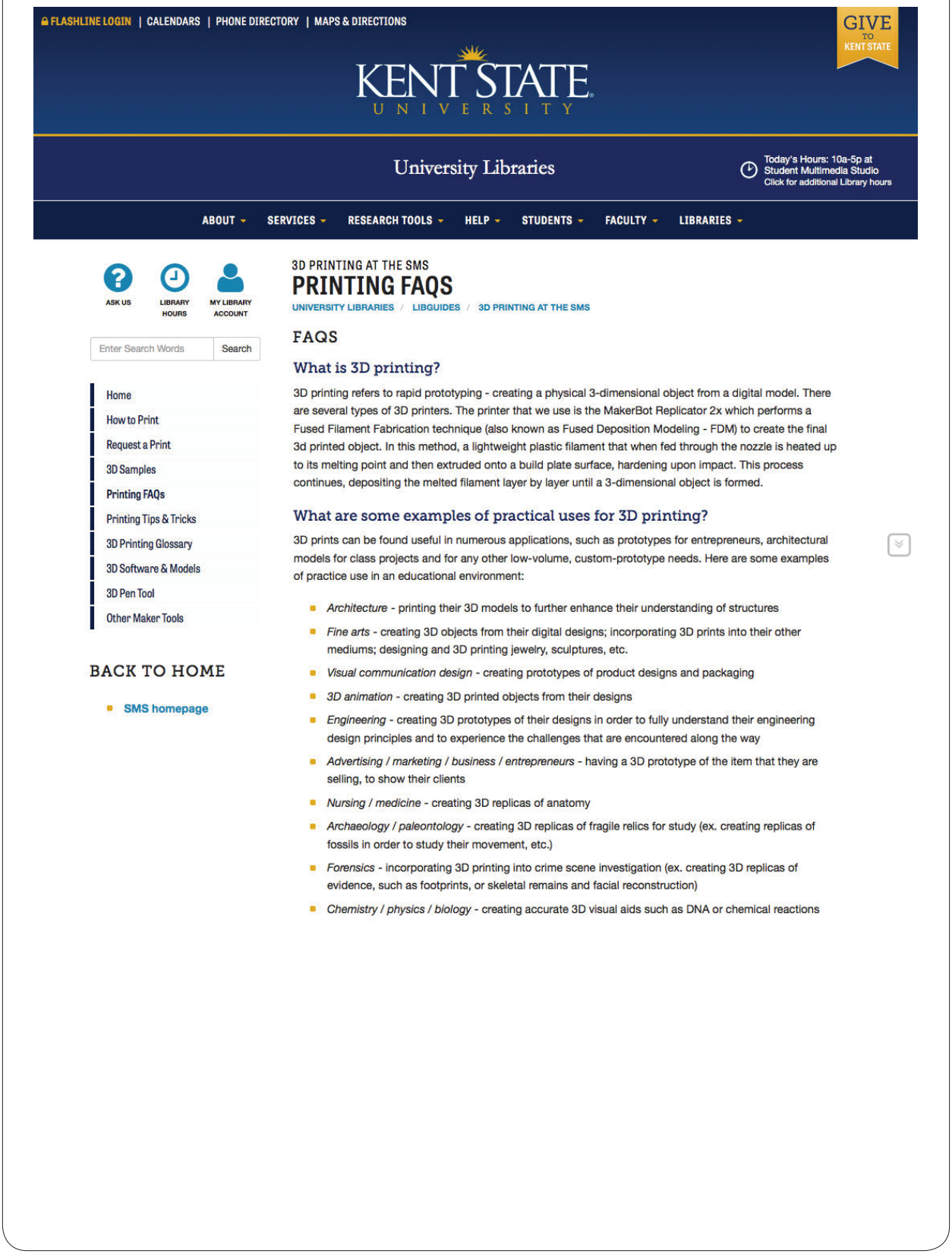
INFO

- MAKE
  DIY projects, how-tos, and inspiration from geeks, makers, and hackers
- www.3ders.org
  3D printer and 3D printing news
- 3D Printing
  Features the latest news on 3D printers, jobs and additive manufacturing companies.

KENT STATE UNIVERSITY
3D Printing at the SMS
http://libguides.library.kent.edu/3d



KENT STATE UNIVERSITY
3D Printing at the SMS | Printing FAQs
http://libguides.library.kent.edu/c.php?g=278293&p=1854417



Who can use the 3D printing service?

The 3D printing service is open to all currently enrolled Kent State students in all disciplines. The actual printing process is performed by our SMS consultants. Have a class of students who wish to 3D print? Contact us first to discuss the assignment so that we can review our policies with you and discuss any limitations that you may have in printing.

How large of an object can you print?

The maximum build volume that we prefer for the Makerbot Replicator 2x is 150 (X) x 150 (Y) x 140 (Z) mm. The max build volume for the Ultimaker 2 is 190 (X) x 195 (Y) x 174 (Z) mm. However, since the printers only run while we are open, the total printing time for a particular model must be under 12 hours, which for a cube-shaped model would equate to a 94 x 94 x 94mm design.

Please be aware that we may ask to print your model at a smaller scale than you would like. We do this with the goal of ensuring the best success of your print. With creative design, though, you can print larger simply by separating your model into smaller printable pieces. So keep that in mind as you prepare your file for printing.

Which 3D modeling software should I use to create a printable design?

We do not have any limitations in the modeling software that you use. We have two file formats that we accept (STL and OBJ) and as long as your software can save or export as one of those formats we should be able to print your model.

Which file formats do you accept?

We accept STL and OBJ files. Most 3D modeling programs can save/export as at least one of those two. Please note, if creating a model in Tinkercad please download your design as an STL file (not an OBJ). For some reason we have difficulty opening OBJ files that have been produced in Tinkercad.

For the full specifications on our 3D printers, visit their official websites:

- Makerbot Replicator 2x
- Ultimaker 2

Last Updated: Aug 19, 2015 1:06 PM **URL:** http://libguides.library.kent.edu/3d Print Page
Tags: 3d modeling, 3d printing, student multimedia studio

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1125 Risman Dr., Kent, OH 44242
PHONE:
330-672-3456
EMAIL:
library@kent.edu

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Makers in Libraries < Program on Information Science

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3D PRINTING GUIDE

HOW CAN I MAKE MODELS SUITABLE FOR PRINTING?

Models may need cleanup and adjustment before they can be printed. These tools and tutorials can help when you are processing your models:

Netfabb Tutorials

Repair Software, helps to fix and repair 3D Files.

A Step-by-step guide with exercise files can be downloaded. 2 video tutorials show how to repair files, check printability and do automatic packing.

Makerbot Customizer on Thingiverse

A Web App, allows to modify existing models. Click **here** to download the App.

Makerbot provides a simple and basic tutorial.

GrabCAD Workbench Tutorials

A cloud-based PDM (product data management) solution, helps to manage, view and share **CAD** files.

8 video tutorials give an overview of GrabCAD Workbencn.

ONLINE RESOURCES

Rapid Prototyping Applications

Finding Models and Scanning Objects

Creating New Models

Preparing Models for Printing

PRINTING SERVICES

Services Inside MIT

Services Outside MIT

INFORMATION

Learning More at MIT

WHAT IS THIS SITE?

This guide contains top information resources for Makers who are interested in making stuff with 3D printers. It is a starting place for your project.

NEED MORE HELP?

More information on how to make stuff from the libraries

Ask the Libraries if you have questions.

Research Consultations - appointments with subject experts for in-depth help.

Tell the Libraries how to serve you better. We want to hear from you.

MICHIGAN STATE UNIVERSITY
Make@State | 3D Printing
https://www.lib.msu.edu/3DPrinting/

MICHIGAN STATE UNIVERSITY
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- Make@State
- Overview
- 3D Printing
  - 3D Print Submission Form
  - 3D Printer Policy
  - 3D Printing FAQ
- Laser Cutter
- Vinyl Cutter
- Borrowable Circuit Tech

3D Printing

Location and Hours

Location: Main Library Copy Center, located on the 2nd floor of the West Wing.
Hours of operation for 3D Printing are in accordance with the Copy Center.

Access

In order to have something printed on our 3D printer, please fill out the 3D Print Submission Form. Prints will be performed in the order they are received and may take a few days depending on order volume.

If you have questions, you can email Make@State Staff or call 517-884-0844.

Cost

Cost will be determined by the filament weight of the item printed. The current rate is $0.20 per gram (All prints under 5 grams will be rounded up to $1.00.) of the total weight of the final print.

General Size to *Price Comparisons:

*Price of object shown subject to change with each individual print.

Why 3D Printing?

3D Printing is a new technology that promotes creativity and innovation. This revolutionary machine provides an opportunity for our patrons to further their learning experience.

How does 3D Printing fit in an Academic Library? It advances the Libraries' Mission...

- By supporting the University's mission of preservation, creation, transmission and application of knowledge
- By providing access to resources to serve educational needs
- Through appropriate facilities and quality service by helpful and expert staff using current technologies, collaborative strategies, and expanding information networks
- By providing an essential facility where emerging and established scholars access information and gather in an atmosphere conducive to learning and other creative endeavors

Some of the departments on campus that are using 3D Printing:

- Apparel/Textile Design
- Arts and Letters
- Business
- Communication Arts and Sciences
- Education
- Engineering
- Interior Design
- Packaging
- Veterinary Medicine

Equipment

MakerBot Replicator 5th Generation

- Affordable, Consumer 3D Printing
- Filament: PLA Plant-based Plastic
- 9.9L x 7.8W x 5.9H inches Build Volume
- 100 Microns (.0039 in) Layer Resolution
- Fused Deposition Modeling (FDM) Technology
- Manufacturer's Details

Filament

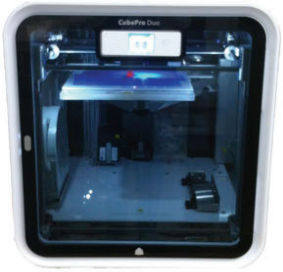
- MakerBot PLA Filament is a bioplastic derived from corn. It is guaranteed not to contain any heavy metals, phthalates or BPA.
- PLA filament comes in a variety of colors. 18 filament colors are available for use on the Copy Center 3D Printer.
- Multi-Colored printing will not be an available service.

Filament Colors Available in the Copy Center:

MakerBot Digitizer 3D Scanner

- $2.00 per scanned object
- 8" x 8" Scan Volume
- Consumer-level 3D scanner optimized for 3D printing
- Fast scan time
- Medium to low resolution scans
- Does not scan color data
- Manufacturer's details

Cube Pro Duo 3D Printer



- Affordable, Consumer 3D Printing
- Filament: ABS
- Build volume: 11.2x9.06x10.6 inches
- Print Resolution: 70 microns in HD, 200 microns in SD, 300 microns in fast mode
- Can print two colors on one print
- Manufacturer's detail

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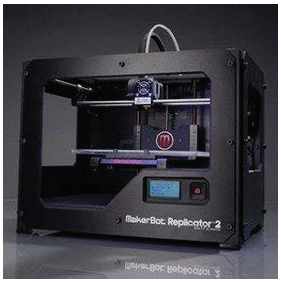
Home › Makerspace › 3D Printing

3D Printing



Tools for 3D printing

Software

The following applications are available on computers in Kenan Science Library. They are also freely available to download to use on your own computer.

3D Design Software

Tinkercad
An easy-to-use web-based tool for creating objects that are ready to be 3D printed. If you haven't done 3D design before, this is a great place to start.

SketchUp
A 3D modeling program for applications such as architectural design, interior design, civil and mechanical engineering, film, and video game design. SketchUp models can be exported to an .OBJ file, which can then be converted to an .STL file using MeshLab (see under "3D Editing and Repair Software").

Blender
A free professional 3D computer graphics software product used for creating animated films, visual effects, art, 3D printed models, interactive 3D applications and video games.

Maya
Maya is a 3D animation, modeling, simulation, rendering, and compositing program. This is licensed software that is available in the Kenan Science Library.

OpenSCAD
A free software application for creating solid 3D CAD objects. It is not an interactive modeler, but rather a 3D-compiler. OpenSCAD reads from a script and renders a 3D model from it.

Getting started

Interested in getting started with 3D printing?

- Read our 3D Printing FAQs
- Read some library resources about 3D printing.
- Jump right in and start using some of the design tools below!

Then,

- Sumit a 3D printing request using this form.
- Set up a consultation to bring in your file and go over search options.

Browse 3D Models

- Thingiverse is a repository of 3D files from hundreds of users.
- The NIH 3D Print Exchange allows for searching, browsing, downloading, and sharing biomedical 3D print files, modeling tutorials, and educational material.
- NASA 3D Resources has a a growing collection of 3D models, textures, and images from inside NASA.
- Smithsonian x 3D is a project to share 3D models developed from scans of their diverse collections.

3D Editing and Repair Software

MeshLab
An open-source general-purpose system aimed at the processing of the typical not-so-small unstructured 3D models that arise in the 3D scanning pipeline. MeshLab is oriented to the management and processing of unstructured large meshes and provides a set of tools for editing, cleaning, healing, inspecting, rendering and converting these kinds of meshes.

MeshMixer
An experimental 3D modeling tool whose goal it is to make it easy to compose new 3D models from existing meshes.

NetFabb
An .STL viewer and repair tool.

Molecular Software Applications

Print your favorite protein using these easy steps

PyMOL
An open-source, user-sponsored, molecular visualization system that can produce high-quality 3D images of small molecules and biological macromolecules, such as proteins.

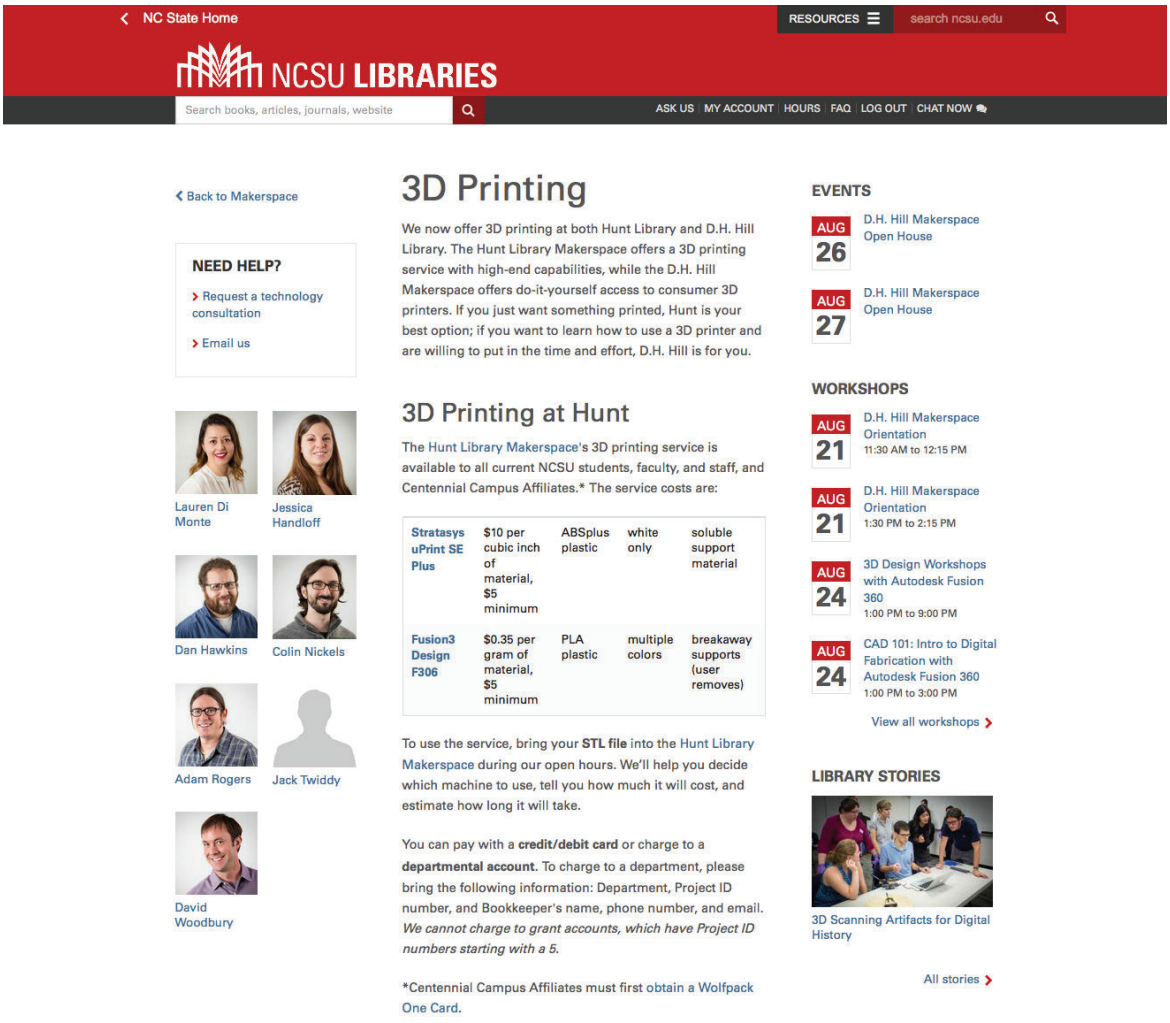
Kokopelli (Mac and Linux only)
Kokopelli is an open-source tool for computer-aided design and manufacturing (CAD/CAM). It uses Python as a hardware description language for solid models. A set of core libraries define common shapes and transforms, but users are free to extend their designs with their own definitions.

3D Printing Service Terms of Use

Those utilizing the library's 3D printer must do so for lawful purposes. Users must abide by all applicable laws (including copyright law (Title 17, U.S. Code) and patent law (Title 35, U.S. Code)), UNC policies, and library policies, while respecting the health and safety of the University community. Kenan Library staff reserve the right to decline any print request for any reason. The Library cannot guarantee model quality or stability, confidentiality of designs, or specific delivery times.

UCSF Chimera
An extensible program for interactive visualization and analysis of molecular structures and related data, including density maps, supramolecular assemblies, sequence alignments, docking results, trajectories, and conformational ensembles. High-quality images and movies can be created.

NORTH CAROLINA STATE UNIVERSITY
Makerspace | 3D Printing
http://www.lib.ncsu.edu/do/3d-printing



3D Printing at Hill

The D.H. Hill Makerspace's 3D printers are available for first-come, first-serve use by current students, faculty, and staff who have attended our D.H. Hill Makerspace Orientation. If you have never used a 3D printer before, our staff can help you get started, though you may want to attend a 3D Printing workshop first for a more thorough introduction.

To use a 3D printer at D.H. Hill, you will need to purchase a spool of filament. We currently sell **PLA filament in a variety of colors for $13.25 per 0.5kg spool** in the Makerspace. You may also bring your own filament in, but be aware that filament varies in quality and print settings across suppliers, even for the same type of plastic.

The 3D printer options at Hill are:

LulzBot Mini	3mm filament	Cura LulzBot Edition software
MakerBot Replicator 2	1.75mm PLA filament	MakerBot Desktop software

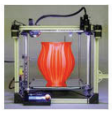
Software

- MeshMixer
- Tinkercad

Spaces

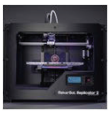
- D.H. Hill Makerspace
- Hunt Library Makerspace

Use in the library



Fusion3 F306 Gen I 3D Printer

Lulzbot Mini



MakerBot Replicator 2 3D Printer

Stratasys uPrint SE Plus 3D Printer

Wanhao Duplicator 4S

FAQ

What is 3D printing? How does it work?

3D printing is the process of making a physical object from a 3D digital model. It is also known as additive manufacturing because the physical model is built up one layer at a time. All of our current 3D printers use a process called Fused Deposition Modeling (FDM), in which a plastic filament is fed through a heated nozzle which melts the plastic. Computer-controlled motors move the nozzle around to create the shape of a layer, which hardens immediately. The object is built this way, one layer at a time, from the bottom up.

What are some practical uses of 3D printing?

There are a multitude of practical applications for 3D printing, from aerospace and automotive engineering to prosthetics and other medical uses. 3D printing enables rapid prototyping of design concepts and functional, working models, and is also used for low-volume, custom, or on-demand manufacturing.

What software can you use to make printable 3D models?

For beginners, we recommend starting with Tinkercad. It is web-based, optimized for 3D printing, and easy to get started with. For a free account, you can join the NCSU Libraries Tinkercad team using this link: http://go.ncsu.edu/tinkercad

However, almost all 3D modeling software will output the filetype (STL) our machines require. There are many options; a few popular ones are SolidWorks, AutoCAD, Inventor, 3DS Max, Creo, Blender, Rhino 3D, and Sketchup. In general, *solid* modelers will be easier to print from than *surface* modelers. Information on software available to students and staff can be found at software.ncsu.edu and www.eos.ncsu.edu/software

Is the library the first place at NCSU to have 3D printers?

No, we are not, but we are the first to offer 3D printing services to all NCSU students, faculty, and staff. The Center for Additive Manufacturing and Logistics on campus has long done research on 3D printing, including with cutting edge processing and advanced materials such as titanium. The College of Design has also long had a 3D printing service for its students.

What if I need to 3D print with higher resolution, faster turnaround time, or different materials?

There are many professional 3D printing services available, including Fineline Prototyping (based in Raleigh) and Shapeways (online).

Contact

D. H. Hill Library
2 Broughton Drive
Campus Box 7111
Raleigh, NC 27695-7111
(919) 515-3364

James B. Hunt Jr. Library
1070 Partners Way
Campus Box 7132
Raleigh, NC 27606
(919) 515-7110

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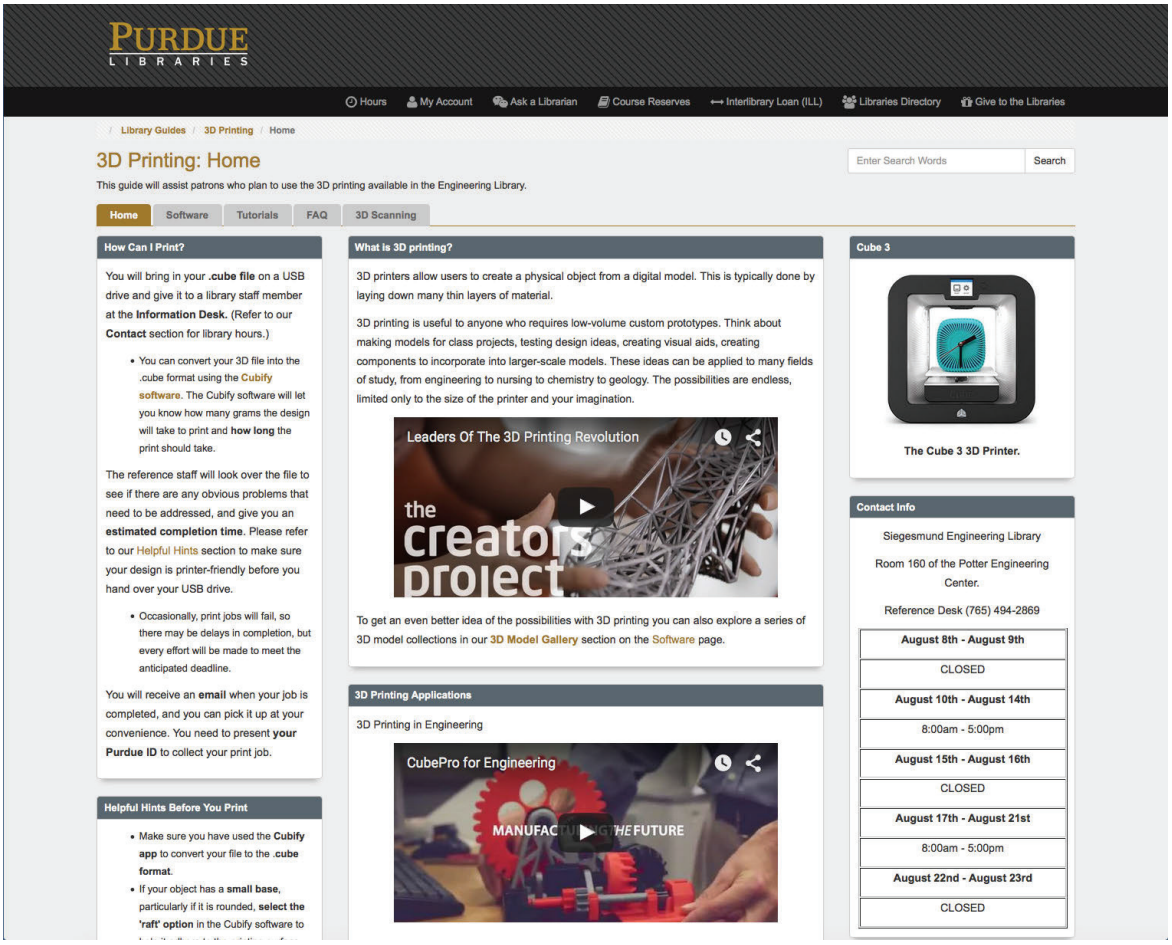
3D Printing: Home
http://guides.lib.purdue.edu/3dprinting



PURDUE UNIVERSITY
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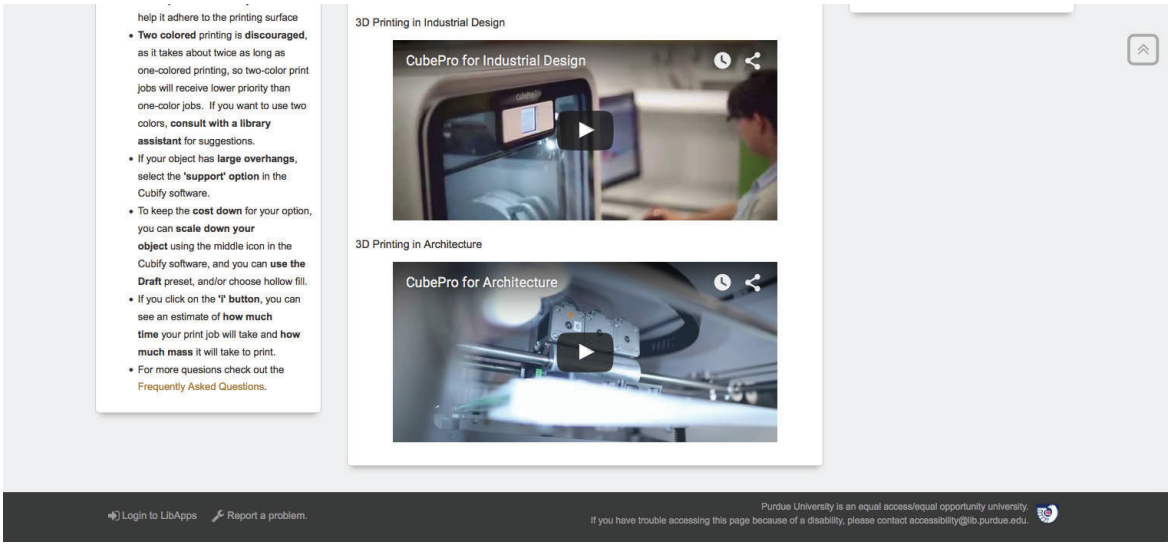
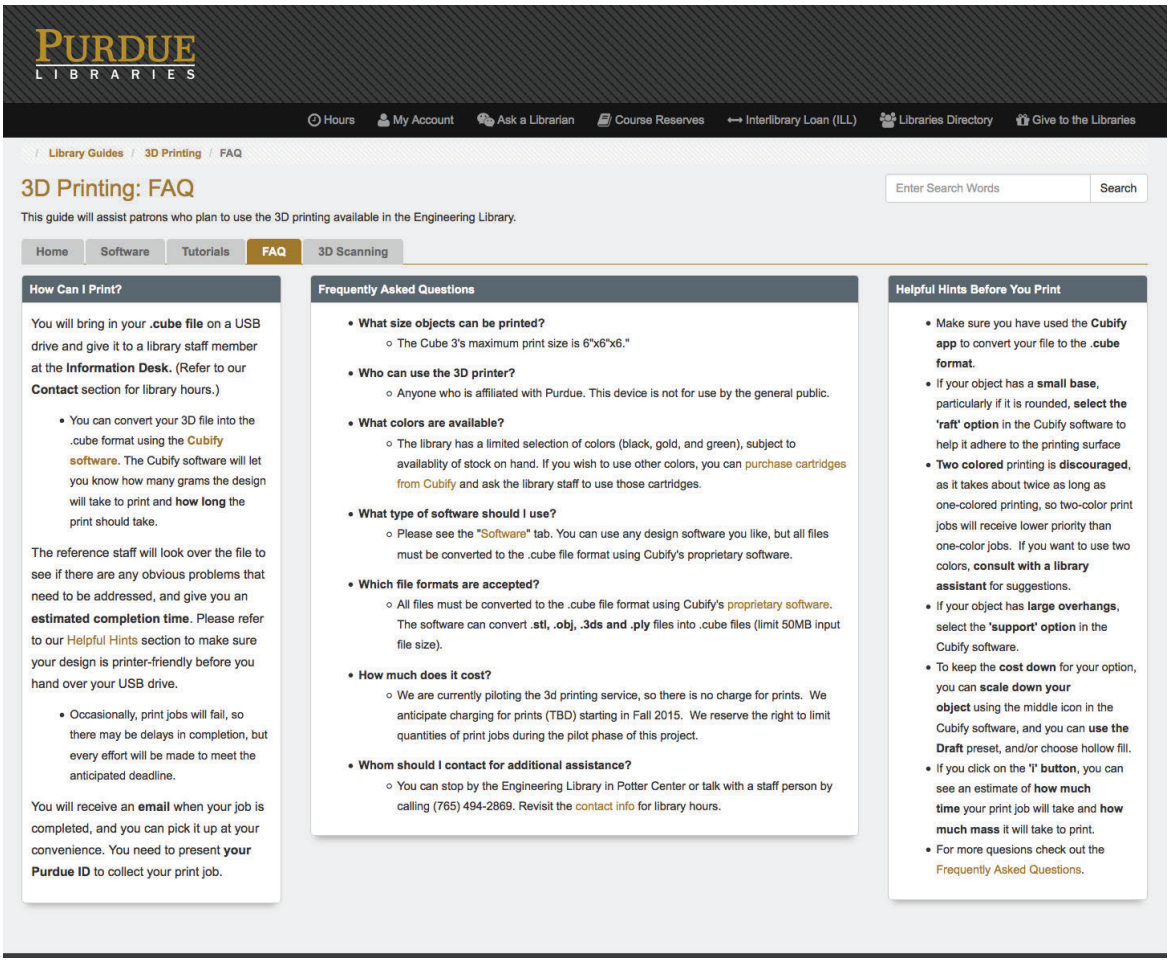
http://guides.lib.purdue.edu/3dprinting



PURDUE UNIVERSITY
3D Printing: FAQ
http://guides.lib.purdue.edu/3dprinting/faq



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Library » Research Guides » Multimedia Creation Resources at the Fordham Commons » FabLab/ Makerspace

Multimedia Creation Resources at the Fordham Commons: FabLab/ Makerspace

Enter Search Words | Search

Available colors

Black

Blue

Orange

Red

Translucent

Translucent Blue

Translucent Purple

Translucent Red

Translucent Yellow

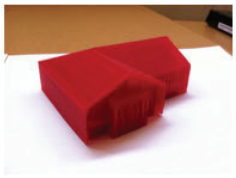
White

Yellow

Printed at the FabLab- Giraffe

Giraffe printed by Chris in Transparent Blue

Building



3D Printing

3D printing is available to members of the Rutgers community

Welcome to 3D printing at the Fordham FabLab on the ground level of the Douglass Library. Just follow signs to the Fordham Commons to find the 3D printers.

We have two MakerBot Replicator 2 printers.

Visit the MakerBot website for more information about MakerBot, Replicator 2, and Makerware

Please contact Stacey Carton at the Media Center or at 848 932 5042 for an appointment. Or email sacarton@rutgers.edu

http://www.makerbot.com/

Getting started

Create a file for 3D printing using our software or one of your own. (.stl file)

Be sure to visit the Makerbot Replicator 2 page to be aware of size and other limitations

Make an appointment with Stacey at the Media Center (848) 932 5042 or ask for details at the Fordham Commons help desk. We will provide you with the cost for printing your project and set up a printing appointment.

Printing costs are $.25/gram, rounded up to the nearest dollar. PLEASE BRING EXACT CHANGE- CASH ONLY. (RIAS available- ask for details)

We will also convert your project to a .x3g file which is compatible with our printers.

You will have a chance to preview your project before printing begins.

Please visit the websites below for more specific information:

http://www.makerbot.com/faq/

http://www.makerbot.com/support/guides/design/

The largest build volume the Replicator can print is

28.5 L x 15.3 W x 15.5 H cm
[11.2 x 6.0 x 6.1 in]

However, we are also limited by time and staff constraints. Please inquire if you have questions about a specific project

Multimedia Resources

Stacey Carton

Email Me

Contact:
Stacey Carton MLIS

sacarton@rci.rutgers.edu

Manager- Fordham Commons- A Multimedia Collaboration Space

Mabel Smith Douglass Library

8 Chapel Drive

New Brunswick, NJ 08901-8527

phone: 848 932-5042

Printed at the FabLab- Raven and Phoenix

Printed by Michael

Printed at the FabLab- Lowpoly Bunny

Examples- Stretchlet Bracelet $2

Examples- Chain Links $1

Examples- House Fly $1

Programs/ Websites

The following software has been installed on the Macs in the Fordham Commons:

Blender 2.70
Makerware 2.4.1.35
Makerware for Digitizer 2.4.1.35
Sculptris Alpha 6
SketchUp Pro 2014 v.14.0.4

We also recommend:

TinkerCad.com. This site requires users to create a login, but offers free "easy-to-use tool for creating digital designs that are ready to be 3D printed into physical objects."

Also, many designs have been uploaded by users to **Thingiverse.com**. Many offer free downloads and many are customizable. Please be aware that there is NO GUARANTEE that these designs will print properly! We cannot be responsible for projects that print incorrectly due to design flaws

The **NIH** offers downloadable designs at http://3dprint.nih.gov/

From the NIH website: "The NIH 3D Print Exchange provides access to a community-contributed database of bioscientific 3D-printable files." The site also offers tools to create 3D printable models from medical images, molecular data, or image stacks. (Login required)

Prosthetic limbs at **E-nabling the Future**

http://enablingthefuture.org/upper-limb-prosthetics/

"A network of passionate volunteers using 3D printing to give the World a "Helping Hand.""

"The e-NABLE community has developed a collection of different 3D-printable assistive devices that are free for download and fabrication by anybody who would like to learn more about the designs or fabricate a device for somebody in need."

Tips and advice

10 tips, including rafts and shells http://talesofa3dprinter.blogspot.com/2013/12/top-10-tips-for-3d-printing-design-from.html

holes and overhangs http://www.instructables.com/id/3D-Design-For-3D-Printing/step2/Overhangs-Part-1-Holes/

extreme overhangs and supports http://www.protoparadigm.com/blog/2012/01/printing-with-support-extreme-overhangs/

45 degree rule and droop http://printa3d.blogspot.com/p/design-tips.html

Creating solid objects http://jcflowers1.iweb.bsu.edu/rlo/makerbot.htm

3D Digitizer

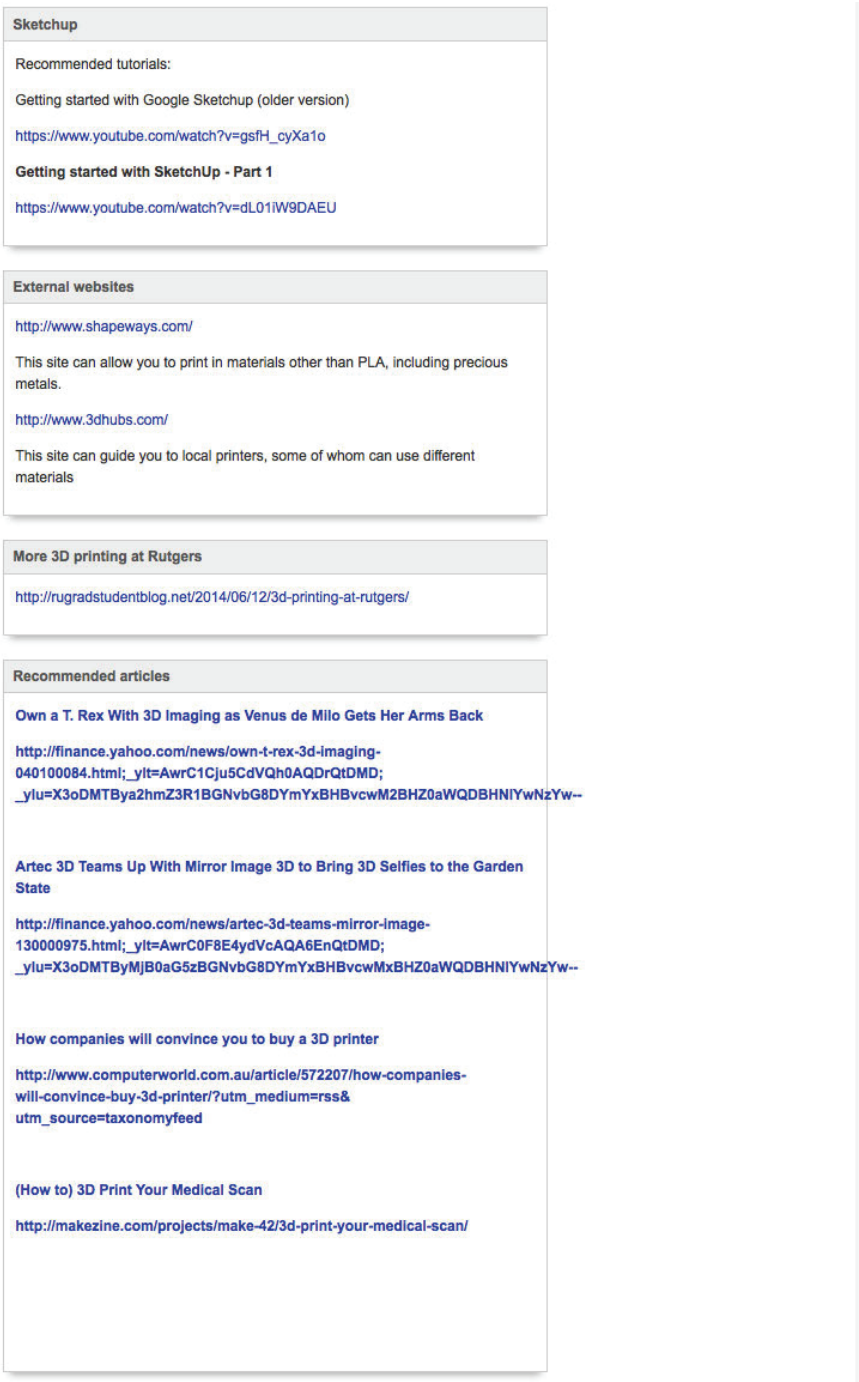
Now available!

Featuring Makerbot Digitizer

3D Scanner

http://store.makerbot.com/digitizer

Scanning is free, but please call ahead for an appointment



Sketchup

Recommended tutorials:

Getting started with Google Sketchup (older version)

https://www.youtube.com/watch?v=gsfH_cyXa1o

Getting started with SketchUp - Part 1

https://www.youtube.com/watch?v=dL01iW9DAEU

External websites

http://www.shapeways.com/

This site can allow you to print in materials other than PLA, including precious metals.

http://www.3dhubs.com/

This site can guide you to local printers, some of whom can use different materials

More 3D printing at Rutgers

http://rugradstudentblog.net/2014/06/12/3d-printing-at-rutgers/

Recommended articles

Own a T. Rex With 3D Imaging as Venus de Milo Gets Her Arms Back

http://finance.yahoo.com/news/own-t-rex-3d-imaging-040100084.html;_ylt=AwrC1Cju5CdVQh0AQDrQtDMD;_ylu=X3oDMTBya2hmZ3R1BGNvbG8DYmYxBHBvcwM2BHZ0aWQDBHNlYwNzYw--

Artec 3D Teams Up With Mirror Image 3D to Bring 3D Selfies to the Garden State

http://finance.yahoo.com/news/artec-3d-teams-mirror-image-130000975.html;_ylt=AwrC0F8E4ydVcAQA6EnQtDMD;_ylu=X3oDMTByMjB0aG5zBGNvbG8DYmYxBHBvcwMxBHZ0aWQDBHNlYwNzYw--

How companies will convince you to buy a 3D printer

http://www.computerworld.com.au/article/572207/how-companies-will-convince-buy-3d-printer/?utm_medium=rss&utm_source=taxonomyfeed

(How to) 3D Print Your Medical Scan

http://makezine.com/projects/make-42/3d-print-your-medical-scan/

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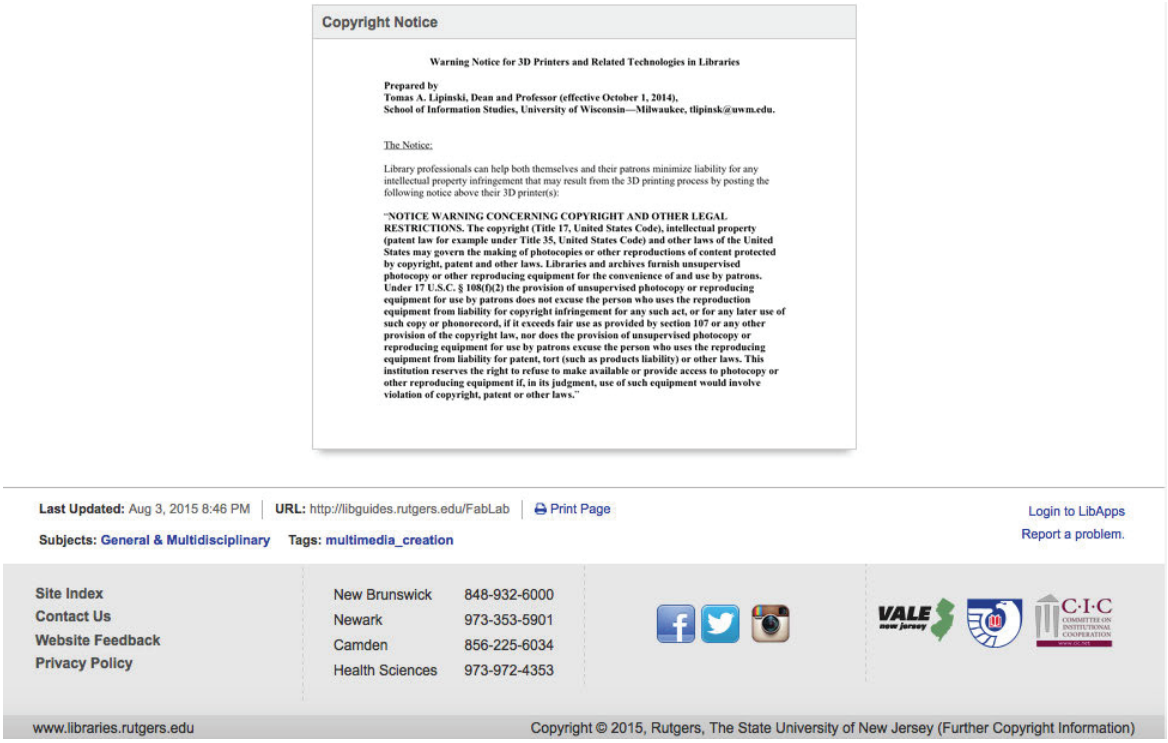
http://libguides.rutgers.edu/FabLab



Copyright Notice

Warning Notice for 3D Printers and Related Technologies in Libraries

Prepared by
Tomas A. Lipinski, Dean and Professor (effective October 1, 2014),
School of Information Studies, University of Wisconsin—Milwaukee, tlipinsk@uwm.edu.

The Notice:

Library professionals can help both themselves and their patrons minimize liability for any intellectual property infringement that may result from the 3D printing process by posting the following notice above their 3D printer(s):

"NOTICE WARNING CONCERNING COPYRIGHT AND OTHER LEGAL RESTRICTIONS. The copyright (Title 17, United States Code), intellectual property (patent law for example under Title 35, United States Code) and other laws of the United States may govern the making of photocopies or other reproductions of content protected by copyright, patent and other laws. Libraries and archives furnish unsupervised photocopy or other reproducing equipment for the convenience of and use by patrons. Under 17 U.S.C. § 108(f)(2) the provision of unsupervised photocopy or reproducing equipment for use by patrons does not excuse the person who uses the reproduction equipment from liability for copyright infringement for any such act, or for any later use of such copy or phonorecord, if it exceeds fair use as provided by section 107 or any other provision of the copyright law, nor does the provision of unsupervised photocopy or reproducing equipment for use by patrons excuse the person who uses the reproducing equipment from liability for patent, tort (such as products liability) or other laws. This institution reserves the right to refuse to make available or provide access to photocopy or other reproducing equipment if, in its judgment, use of such equipment would involve violation of copyright, patent or other laws."

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TAGS: 3D, 3D PRINT, 3D PRINTER, 3D PRINTING, 3D SCANNER, 3D SCANNING, MAKERBOT

A guide to 3D Printing at Morris Library.

Last Updated: Aug 17, 2015 | URL: http://libguides.lib.siu.edu/3d | Print Guide | RSS Updates | Email Alerts

Home | 3D Modeling Software & Free Models | Request a Print | Examples printed at Morris | Policies & Procedures | Resources
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Home | Print Page | Search: | This Guide | Search

IMPORTANT INFORMATION

Required File Format:

.STL or .OBJ

Maximum Object Size:

225 x 145 x 150 mm

8.85 x 5.7 x 5.9 in

PLA filament colors currently available:

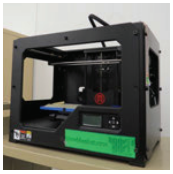
Silver
Black
Red
White
Orange
Green
Natural
Glow In the Dark
Blue
Yellow
Purple

Cost per object:

$0.25 per gram

$1.00 minimum

INTRODUCTION



3D Printing can turn your ideas into actual objects.

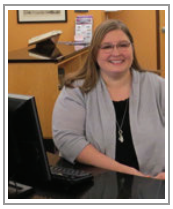
Through a generous loan by the non-profit organization New Blankets, Morris Library now has a 3D Printer. This printer allows the user to create physical objects from digital models. All members of the university community and the public are encouraged to make use of this exciting technology.

3D printing is sometimes referred to as additive manufacturing or rapid prototyping. It is the process of creating a three dimensional physical object from a digital model. The 3D printer builds the object vertically by putting down layer upon layer of a plastic filament called PLA.

3D PRINTING STEPS

1. Design a 3D model or find one on a site like Thingiverse.
2. Read the Morris Library Printing Policy. If your print is time sensitive, please allow adequate time. Most prints will be finished in a few days, but there may be times that the printer is malfunctioning, being repaired, experiencing heavy use, or is being used for an event or a course.
3. Make sure your file is in .STL or .OBJ format.
4. Fill out and submit a **3D Printing Request Form**. If you have any special instructions, please include them in the Additional Comments box on the form. After you have submitted the form, the next screen will include the location to submit your .STL or .OBJ file. To upload your .STL or .OBJ file, click Browse under the Attach files option. Find and select your file. Only .STL or .OBJ files will be accepted. Once you have added your .STL or .OBJ file, click the Upload file button. If you want to print more than one object, make sure to submit a file and form for each one.
5. Optional - If you wish, set up a consultation or appointment with a member of the library staff to print your model yourself or watch it print. If you choose this option, someone will contact you about scheduling a time.
6. Library staff will email you with a confirmation of your submission and any follow-up questions.
7. Once your model has been printed, you will receive another email letting you know the cost of the object and how long you have to pick it up.
8. Pick up your model at the Morris Library Circulation Desk on the first floor. You will also pay for your object at the Circulation Desk.
9. Enjoy your object and start designing something new!

SUBJECT GUIDE



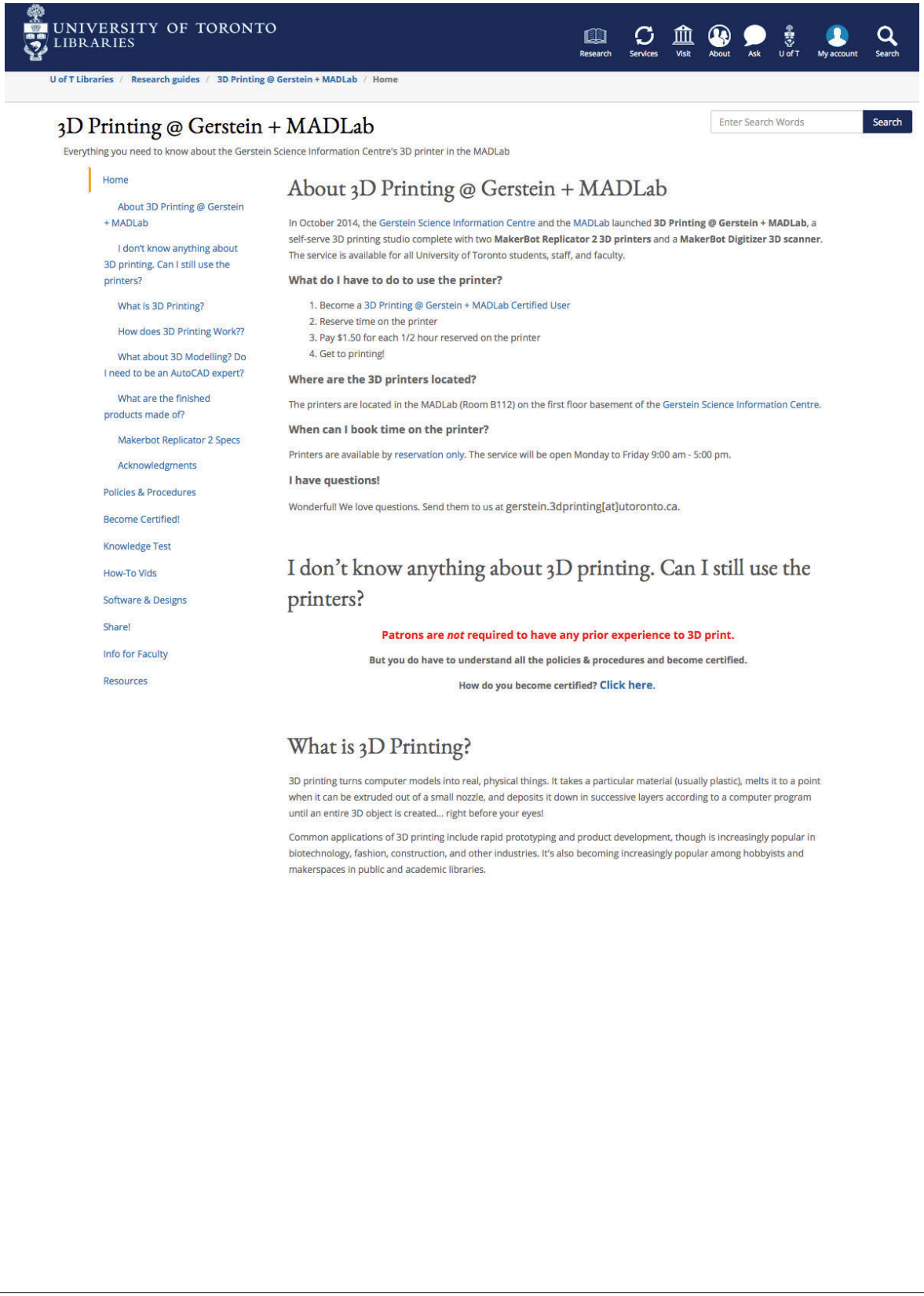
Jennifer Horton

Contact Info
Morris Library
Room 260D
Southern Illinois University
Carbondale, IL
(618) 453-2663
Send Email

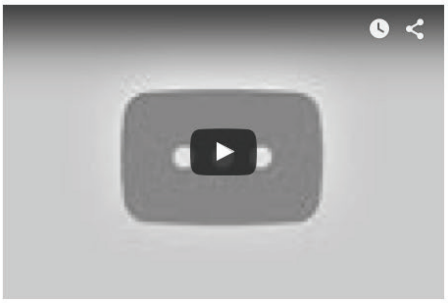
Links:
Profile & Guides

Subjects:
Chemistry and Biochemistry, Computer Science, Geology, Mathematics, Physics, Civil and Environmental Engineering, Industrial Technology, Electrical Engineering, Mechanical Engineering and Energy Processes, Mining and Mineral Resources Engineering

UNIVERSITY OF TORONTO
3D Printing @ Gerstein + MADLab
http://guides.library.utoronto.ca/3dprinting



How does 3D Printing Work??



What about 3D Modelling? Do I need to be an AutoCAD expert?

no AutoCAD required! no 3D modelling *at all* required!

There are a ton of fun, innovative, and simple designs that you can download for free from online libraries of 3D designs. We recommend that if you are new to 3D printing, try printing something small and quick. We've put together a list of objects you can print to get experienced.

We love Thingiverse. Browse or search the HUGE collection of free pre-designed models that you download free of charge! Still a little unsure? Choose designs that have a picture of the finished object.

want to design your own 3D object?

There are also loads of free, easy-to-use 3D modelling software programs out there. Stay tuned for information about free workshops we'll be offering on how to use these software programs or check out these handy online resources.

you're an AutoCAD expert who wants to print your own designs?

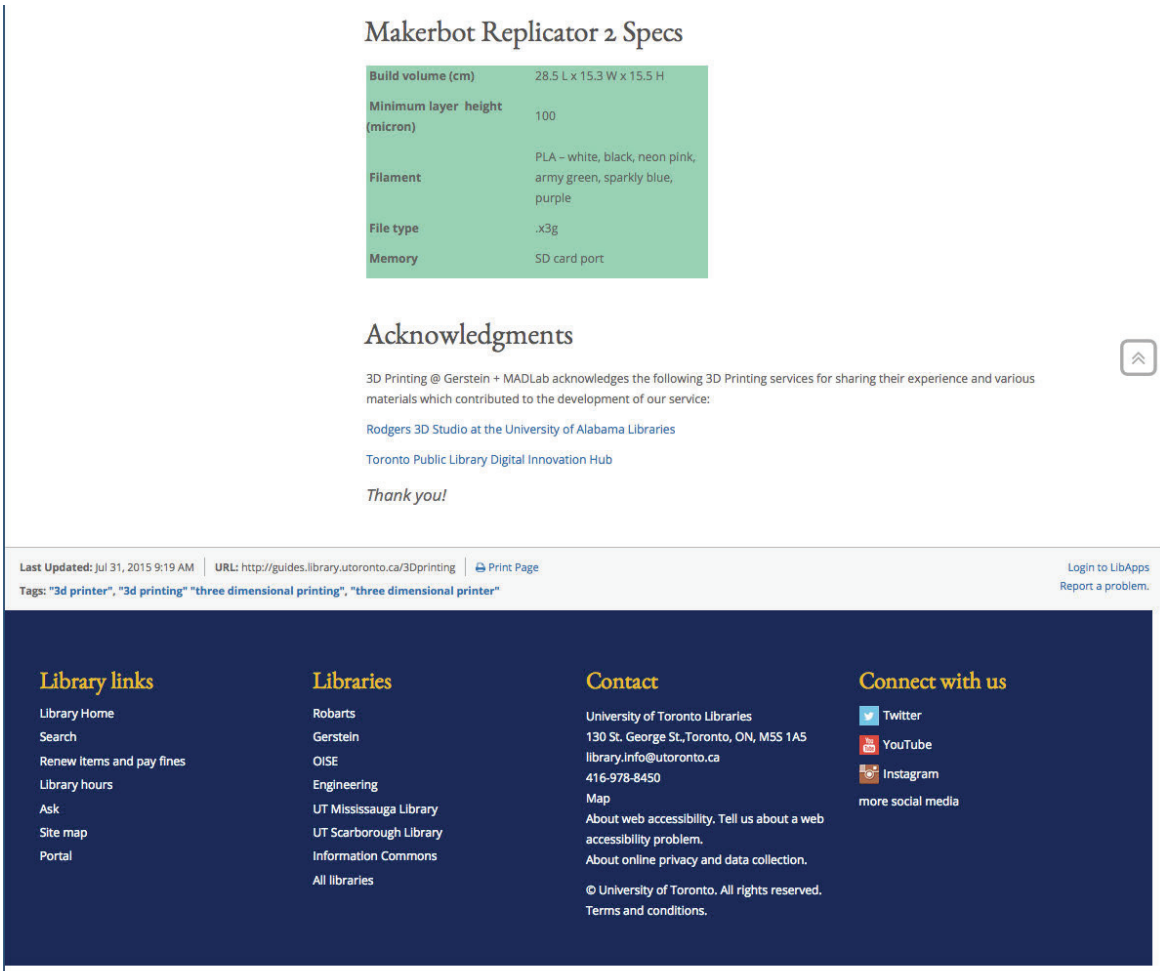
Great! As long as you run your design through the MakerWare software to check for problematic design elements and adhere to the policies and procedures of our service, you **can** print your objects of your own design. We're excited to see what you can do!

What are the finished products made of?

The 3D printers at Gerstein + MADLab use PLA (polyactic acid), a biodegradeable thermoplastic aliphatic polyester dervied from corn starch. It's safe to use in our space. You can view the PLA Material Data Safety Sheet.

We currently have filament in 6 colours: white, **black**, neon pink, army green, sparkly blue and purple. Unless otherwise requested, you'll print your job in whatever colour is loaded into the printer when you begin your reservation. If you would like to print in a specific colour that we offer, please email us ahead of time and we can help you switch out the filament.

Also note that white PLA can easily be painted.



Makerbot Replicator 2 Specs

Build volume (cm)	28.5 L x 15.3 W x 15.5 H
Minimum layer height (micron)	100
Filament	PLA – white, black, neon pink, army green, sparkly blue, purple
File type	.x3g
Memory	SD card port

Acknowledgments

3D Printing @ Gerstein + MADLab acknowledges the following 3D Printing services for sharing their experience and various materials which contributed to the development of our service:

Rodgers 3D Studio at the University of Alabama Libraries

Toronto Public Library Digital Innovation Hub

Thank you!

Last Updated: Jul 31, 2015 9:19 AM | **URL:** http://guides.library.utoronto.ca/3Dprinting | Print Page

Tags: "3d printer", "3d printing" "three dimensional printing", "three dimensional printer"

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Equipment, Software, and Models

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3D Modeling Resources
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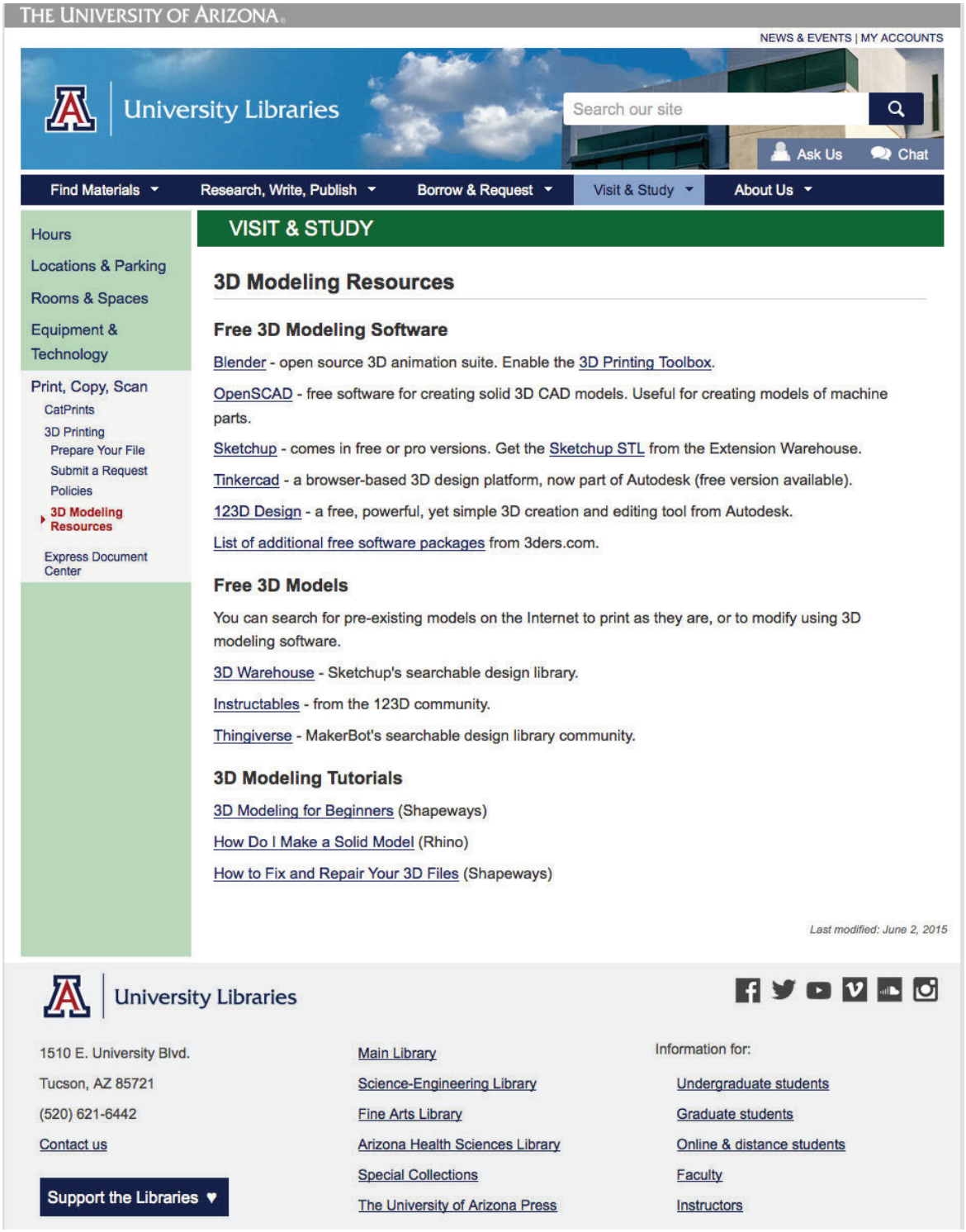

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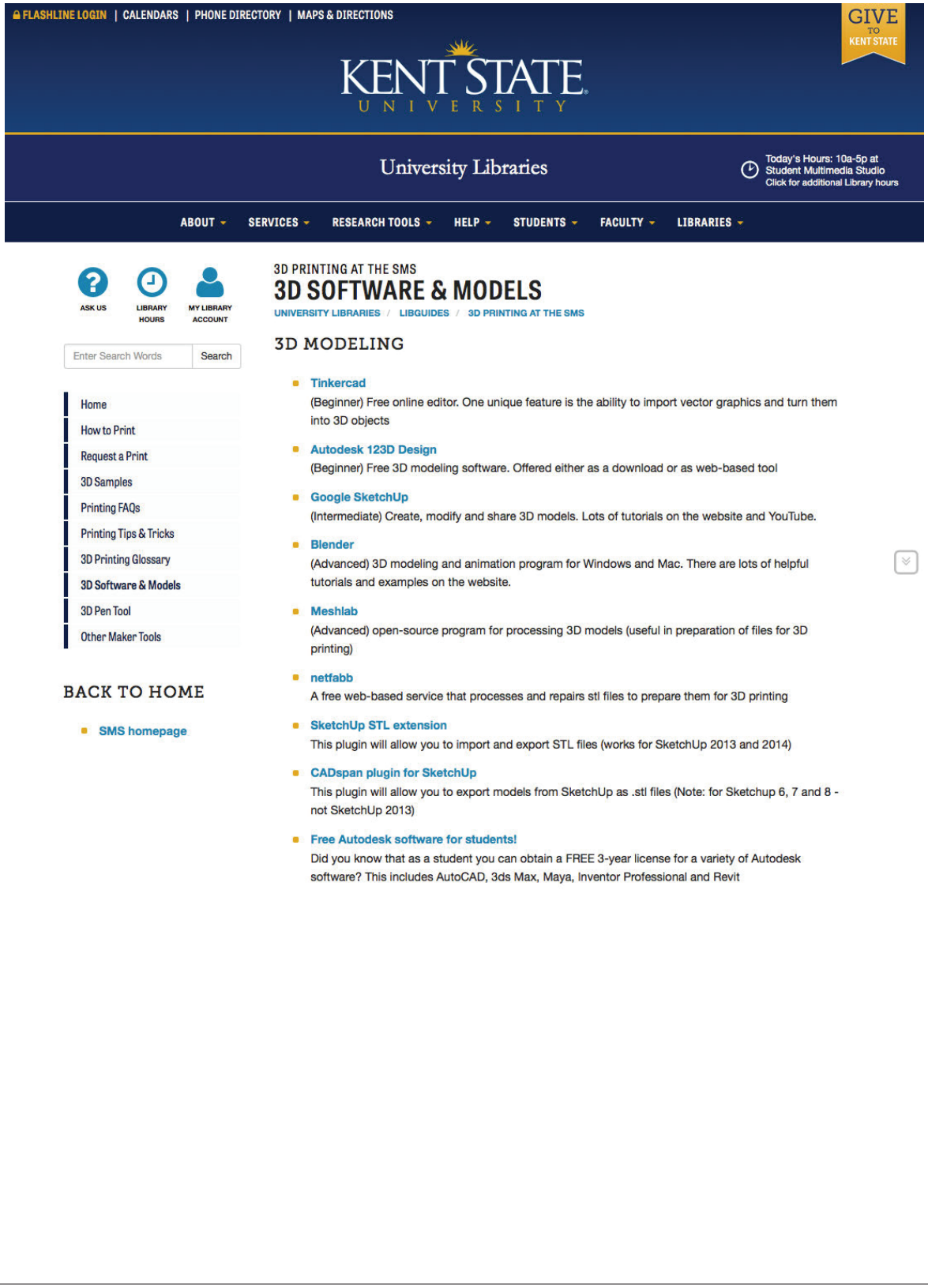
3D Printing at the SMS | 3D Software & Models
http://libguides.library.kent.edu/c.php?g=278293&p=1854414



KENT STATE UNIVERSITY
3D Printing at the SMS | 3D Software & Models
http://libguides.library.kent.edu/c.php?g=278293&p=1854414

MOBILE 3D MODELING APPS

- **123D Catch**
  Turn your object into a 3D model with photos! Works on iPad/iPhone or also as a web-based app
- **123D Sculpt**
  Sculpt in 3D using this free iPad app.
- **MakerBot PrintShop**
  The Shape Maker feature in this free iPad app allows you to convert basic 2D sketches or images into printable 3D models

ONLINE 3D MODELING COMMUNITIES

- **Thingiverse**
  from Makerbot - a place to share and download free printable 3D model designs
- **Smithsonian X 3D**
  The Smithsonian is in process of digitizing its collection in 3D and offers free, downloadable model files
- **Sketchfab**
  Online community for publishing and browsing 3D models - some offer the option to download
- **YouMagine.com**
  a file-sharing 3D printing community with a built-in web-based 3d modeling tool
- **My Mini Factory**
  Downloadable 3D models (some free); sign up for a free account to earn free credits toward downloads; upload your own designs to earn more credits (and can even charge for your models)
- **Shapeways**
  Make, buy and sell 3D printed products
- **Ponoko**
  Make, share, buy or sell 3D product designs

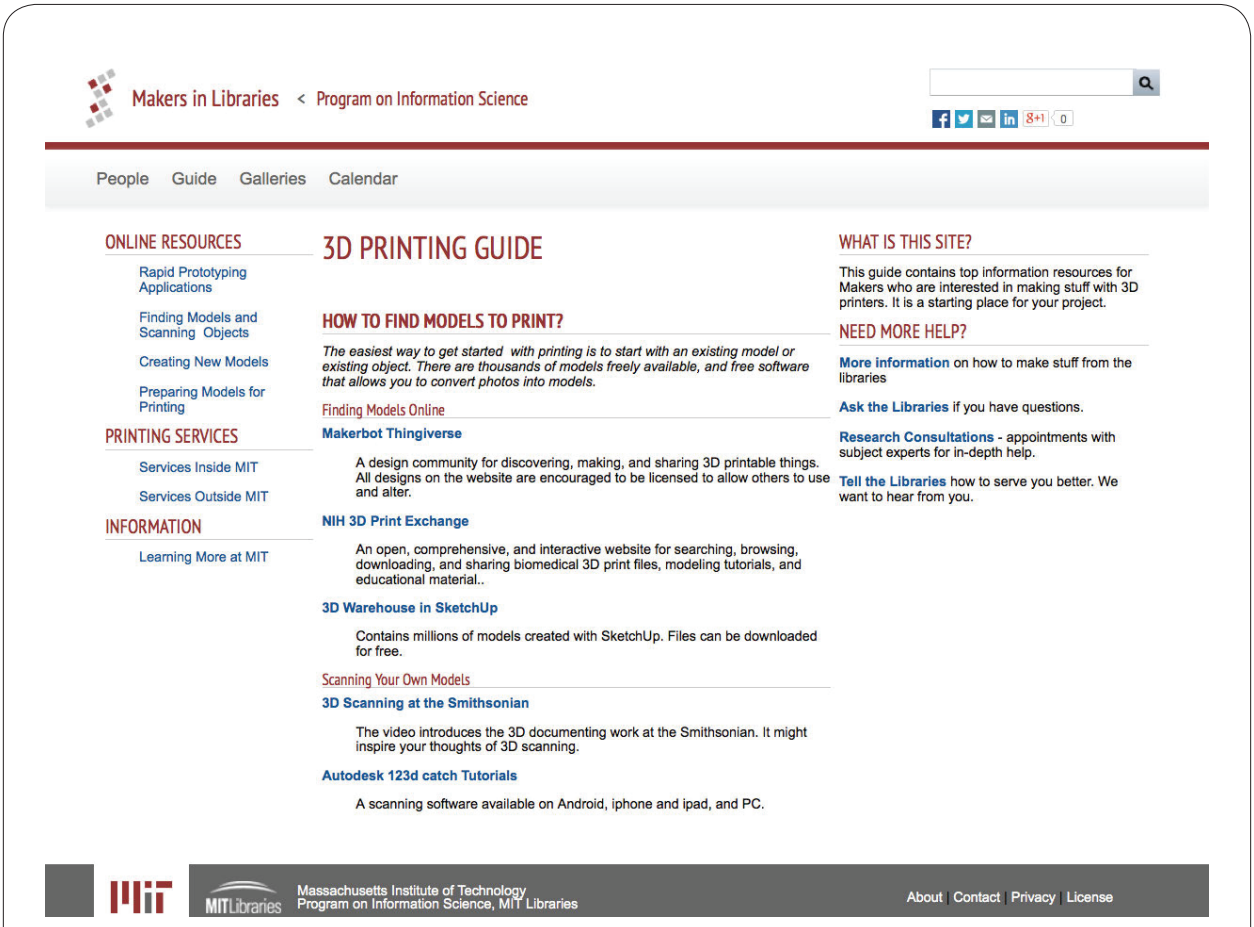
3D PRINTING SOFTWARE

Most 3D printers use specific software to prepare model files for print. Sometimes it is helpful to preview your model in the 3D printing software in order to have a better understanding of how your model will be produced (sizing, supports needed, etc.) while also helping you spot potential printing issues. Here are the free software programs for our 3D printers, available for download:

- **Makerbot Desktop**
  (free) 3D printer software for the Makerbot Replicator 2x
- **Cura**
  (free) 3D printer software for the Ultimaker 2

Last Updated: Aug 19, 2015 1:06 PM **URL:** http://libguides.library.kent.edu/3d **Print Page** Login to LibApps
Tags: 3d modeling, 3d printing, student multimedia studio

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
3D Printing Guide | How to Find Models to Print?
http://projects.informatics.mit.edu/maker/3d-printing-libguide/3



UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Makerspace | Equipment & Software
http://library.unc.edu/makerspace/equipment-software/

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Home › Makerspace › Equipment & Software

Equipment & Software

Equipment

Fusion3 F306

Build Volume
12 x 12 x 12 in.

Print Material
PLA (polylactic acid) bioplastic

File Type
.STL

Operating Systems
Windows (7+), Mac OS X (10.6+), LINUX (UBUNTU 12.04+)

Connectivity
USB, SD Card

MakerBot Replicator 2

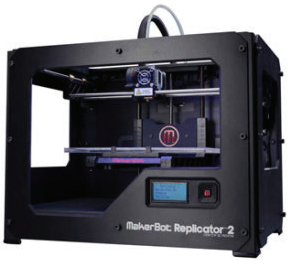
Build Volume
11.2 x 6 x 6.1 in.

Print Material
PLA (polylactic acid) bioplastic

File Type
.STL

Operating Systems
Windows (7+), Mac OS X (10.6+), LINUX (UBUNTU 12.04+)

Connectivity
USB, SD Card



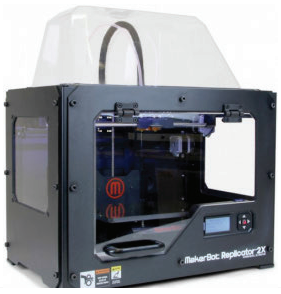
MakerBot Replicator 2X

Build Volume
9.7 x 6 x 6.1 in.

Print Material
ABS filament or MakerBot dissolvable filament; capable of printing in two interlaceable colors

File Type
.STL

Operating Systems
Windows (7+), Mac OS X (10.6+), LINUX (UBUNTU 12.04+)



Connectivity
USB, SD Card

MakerBot Replicator Mini

BUILD VOLUME
3.9 x 3.9 x 4.9 in.

Print Material
PLA (polylactic acid) bioplastic

File Type
.STL

Operating Systems
Windows (7+), Mac OS X (10.7+), LINUX (UBUNTU, Fedora)

Connectivity
Wi-Fi, USB

Sense 3D Scanner

This is a portable, easy-to-use 3D scanner. The Sense 3D Scanner can be checked out of the library for a 24 hour period of time.

Software
Sense scanning software

NextEngine 3D Scanner

This Full color, high resolution, professional 3D scanner can produce 3D-printable files.

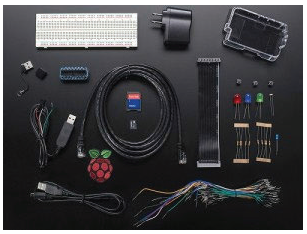
Software
ScanStudioHD

Raspberry Pi Starter Pack

Raspberry Pi kits can be used in the library for 4 hours at a time or checked out of the library overnight.

Contains:

- Raspberry Pi Model B 512MB RAM
- Adafruit Pi Case
- 3′ long USB Micro-B Cable
- 5V 1A power adapter
- USB TTL console cable
- 4GB SD Card
- Assembled Adafruit Pi Cobbler kit with GPIO cable
- USB microSD card reader



- Large full-size breadboard
- Breadboarding wires
- 10' long Ethernet cable
- 5 x 10K resistors for pullups on the buttons
- 5 x 560 ohm resistors for the LEDs
- 1 red 10mm diffused LED
- 1 green 10mm diffused LED
- 1 blue 10mm diffused LED
- 3 tactile pushbuttons
- Light-sensitive resistor photocell
- 1uF capacitor

Hakko-FX888D Soldering Iron

Procedures and policies.

Singer 9410 Sewing Machine

Procedures and policies.

Software

3D Design and Editing

Blender
kokopelli (Mac only)
MakerBot Desktop
Maya
MeshLab
meshmixer
netfabb
OpenSCAD
PyMOL
SketchUp
UCSF Chimera

Electronics

Arduino IDE
Processing

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3D Printing: Software
http://guides.lib.purdue.edu/3dprinting/software

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3D Printing: Software

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This guide will assist patrons who plan to use the 3D printing available in the Engineering Library.

Home | Software | Tutorials | FAQ | 3D Scanning

Getting Started

There are two kinds of software you will need to use prior to printing.

- Design Software - to create your design
- Printing Sofware - to print your design

Looking for inspiraion? Be sure to check out the 3D Model Gallery to explore different collections.

Design Software

To create your own designs you have quite a few different options in design software. **All of the following programs are free** for you to use to create 3D models. Looking for inspiraion? Be sure to check out the **3D Model Gallery** below to explore premade designs.

- AutoCAD
  - Currently available on ITAP computers.
- TinkerCAD
  - A web-based program fo the beginner.
- Blender
  - Blender is a powerful, free, open source tool for creating 3D animation and models for 3D printing.
- SketchUp Make
  - Make Marketed for 'hobbyists, kids and backyard spaceship builders,' Sketchup is user-friendly and forgiving. Ideal for novices. Also comes in a paid Pro version.
- OpenSCAD
  - Ideal for creating solid 3D CAD models. Great for models of machine parts.

Printing Software

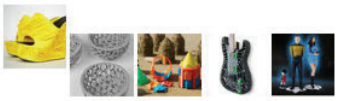
The Cube will only print **.cube** 3D files. Dowload the Cubify software to convert your file by clicking the link below.

- Cubify Printing Software

3D Model Gallery

If you're just looking for inspiration or want to explore the possibilities of 3D printing check out the following collections with downloadable 3D model designs.

- Cubify - Cubify has many .cube files available both for free download and for purchase.



  - Cubify Fashion - Fashion designs for both men and women including shoes, jewerly, watches, phone cases and more.
  - Cubify Decor - Designs for the home. Think frames, desktop accessories, barware and more.
  - Cubify Kids - This collection includes all kinds of fun toys and accessories.
  - Cubify Entertainment - This collections includes games, music, food, and even licensed products. You can even print a personalized super hero action figure!
  - Cubify Mancave - Not just for men, this collection includes all kinds of gadgets and devices.
- Thingiverse - Thingiverse is a community dedicated to sharing 3D designs.

  - Thingiverse has hundreds of user-submitted designs organized in categories and collections including Art, Gadgets, Learning, Tools and Fashion that are free to download.

If you do choose to use a downloaded file, be sure to read through the Helpful Hints section above to make sure your design is printer-friendly prior to printing.

Helpful Hints Before You Print

- Make sure you have used the **Cubify app** to convert your file to the **.cube format**.
- If your object has a **small base**, particularly if it is rounded, **select the 'raft' option** in the Cubify software to help it adhere to the printing surface
- **Two colored** printing is **discouraged**, as it takes about twice as long as one-colored printing, so two-color print jobs will receive lower priority than one-color jobs. If you want to use two colors, **consult with a library assistant** for suggestions.
- If your object has **large overhangs**, select the **'support' option** in the Cubify software.
- To keep the **cost down** for your option, you can **scale down your object** using the middle icon in the Cubify software, and you can **use the Draft** preset, and/or choose hollow fill.
- If you click on the **'i' button**, you can see an estimate of **how much time** your print job will take and **how much mass** it will take to print.
- For more quesions check out the Frequently Asked Questions.

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SOUTHERN ILLINOIS UNIVERSITY CARBONDALE
3D Printing at Morris Library | 3D Modeling Software & Free Models
http://libguides.lib.siu.edu/content.php?pid=551069&sid=4540922

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3D PRINTING AT MORRIS LIBRARY

TAGS: 3D, 3D PRINT, 3D PRINTER, 3D PRINTING, 3D SCANNER, 3D SCANNING, MAKERBOT

A guide to 3D Printing at Morris Library.

Last Updated: Aug 17, 2015 | URL: http://libguides.lib.siu.edu/3d | Print Guide | RSS Updates | Email Alerts

Home | 3D Modeling Software & Free Models | Request a Print | Examples printed at Morris | Policies & Procedures | Resources
3D Printing Terms | Previous Tips of the Week | Virtual Exhibits Information

3D Modeling Software & Free Models Print Page Search: This Guide Search

FREE 3D SOFTWARE

- **Tinkercad**
  Tinkercad has a free version of its software that creates 3D digital models. This is a great program for beginners and is used in the web browser.
- **Autodesk 123D Design**
  Free design software that can be used as a web app, downloaded to PC or Mac, or as an iPhone/ipad app. This is a great program for beginners.
- **SketchUp**
  SketchUp Make is a free 3D drawing tool.
- **Blender**
  Blender is a free open source computer graphics software that can be used for 3D modeling.
- **Sculptris**
  Sculptris is a virtual sculpting program.
- **OpenSCAD**
  OpenSCAD is a free software to create solid 3D CAD objects.
- **Meshlab**
  Meshlab is an free open source program for processing and editing unstructured 3D triangular meshes.
- **Meshmixer**
  Meshmixer is a free prototype design tool.
- **Netfabb**
  Netfabb is a free software that processes and repairs stl files to prepare them for 3D printing.

OBJECT REPOSITORIES / COMMUNITIES

- **Thingiverse**
  Thingiverse is a community to discover, make, and share 3D models. Users can download files of objects that others have made. Several of the objects can be customized and modified.
- **Yeggi**
  Yeggi is a search engine to find 3D printable objects.
- **Repables**
  Open repository of digital files suitable for 3D printing.
- **Sketchup 3D Warehouse**
  Sketchup's design library of 3D models.
- **Smithsonian X3D**
  Collection of 3D models of various artifacts from the Smithsonian Museums.
- **NIH 3D Print Exchange**
  Search, browse, download, and share 3D biomedical printable models including custom labware.
- **NASA 3D Resources (Beta)**
  NASA's 3D resources site that includes several printable models in .STL format.
- **British Geological Survey**
  Site contains many 3D models of fossils. You can download an OBJ file to use in 3D printing.
- **AfricanFossils.org**
  Africanfossils.org has several 3D models of significant fossils and artifacts in categories such as hominids, animals, and tools. It is a partnership with Autodesk, National Geographic, the Turkana Basin Institute, the National Museum of Kenya, and Stony Brook University.
- **The Collection - Art & Archaeology Museum**
  3D Scan project by artist Oliver Laric at The Usher Gallery at The Collection in Lincolnshire, UK.
- **The Virtual Hamspon Museum**
  3D scans of Native American artifacts from the Hampson Archeological Museum State Park in Wilson, Arkansas. OBJ files are included.

CONTACT MORRIS
Morris Library
Southern Illinois University
Carbondale, IL 62901
Information Desk: (618) 453-2818
Administrative Office: (618) 453-2522
Circulation Desk: (618) 453-1455
Web Administrator

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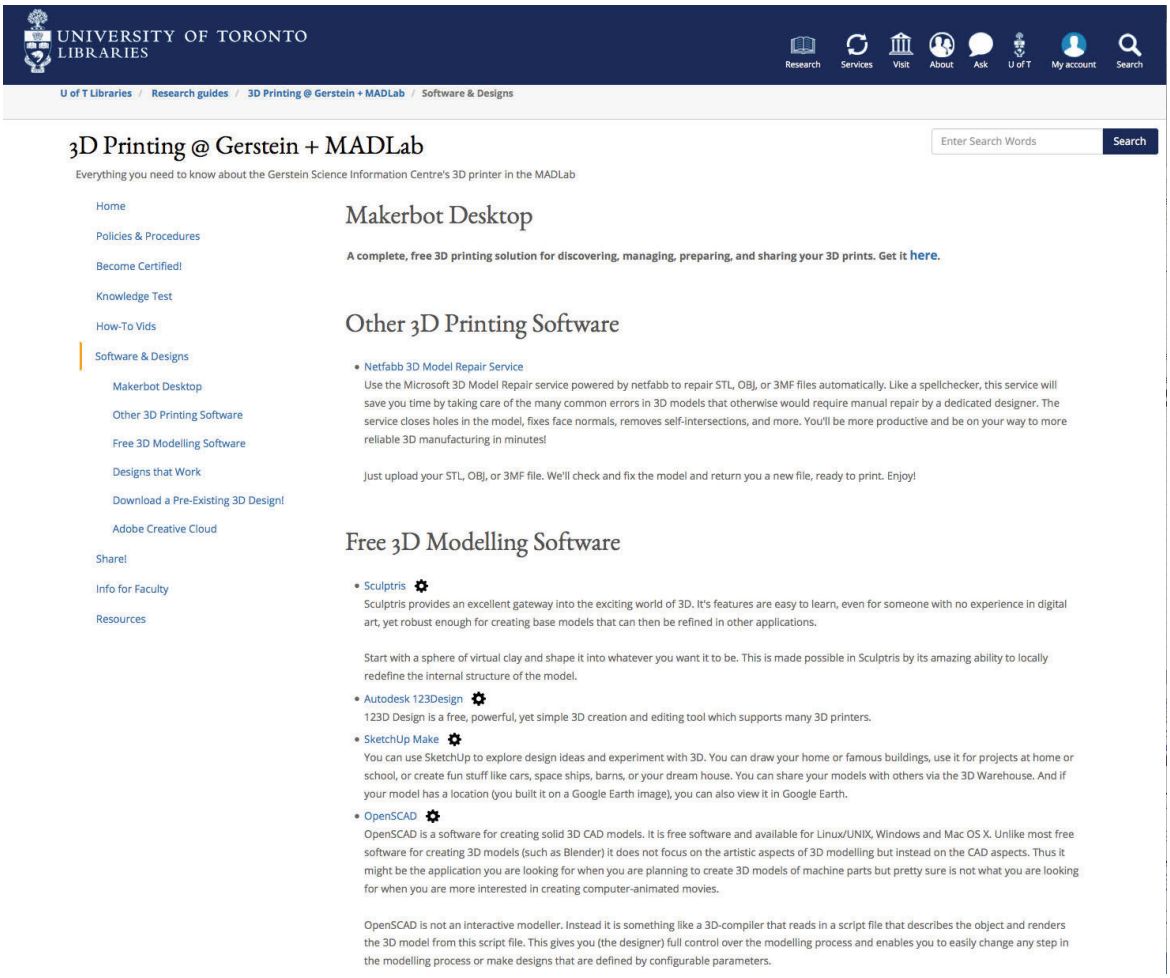
http://guides.library.utoronto.ca/c.php?g=251855&p=1678121



- Blender
  Blender is a free and open source 3D animation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation. Advanced users employ Blender's API for Python scripting to customize the application and write specialized tools; often these are included in Blender's future releases. Blender is well suited to individuals and small studios who benefit from its unified pipeline and responsive development process.

Designs that Work

The Makerbot Replicator 2 ships with various easy-to-print, successful designs pre-loaded on an SD card. If you are brand new to 3D printing and just want to print something quick and easy, these designs might be what you want to start with. From chain links, to a stretchy bracelet, to a nut-and-bolt and mr. jaws, these designs do a great job of demonstrating the potential of 3D printing, while taking less than an hour (most are under 30 minutes) to complete!

Check out 3D Printing @ Gerstein + MADLab's smart collection of easy first-time prints on Thingiverse for more inspiration!

Download a Pre-Existing 3D Design!

It's like a thing. 3D designers and printers like to share their work. Check out the links below and search for or browse for a design that suits your fancy. If you're a beginner, we recommend going with designs that have a picture of the finished product. That way, you might be able to tell if it'll work!

- Thingiverse
  Browse the world's largest 3D design community for discovering, printing, and sharing 3D models. Join over 130,000 community members in downloading, sharing, and remixing 3D designs.
- NIH 3D Print Exchange
  Few scientific 3D-printable models are available online, and the expertise required to generate and validate such models remains a barrier. The NIH 3D Print Exchange eliminates this gap with an open, comprehensive, and interactive website for searching, browsing, downloading, and sharing biomedical 3D print files, modeling tutorials, and educational material.

  The NIH 3D Print Exchange is a collaborative effort led by the National Institute of Allergy and Infectious Diseases in collaboration with the Eunice Kennedy Shriver National Institute for Child Health and Human Development and the National Library of Medicine.
- Smithsonian X 3D
  Smithsonian X 3D launches a set of use cases which apply various 3D capture methods to iconic collection objects, as well as scientific missions. All of these uses cases are accessible through the Beta Smithsonian X 3D Explorer, as well as videos documenting the project. For many of the 3D models, raw data can be downloaded to support further inquiry and 3D printing.
- NASA 3D Resources
  Here you'll find a growing collection of 3D models, textures, and images from inside NASA. All of these resources are free to download and use. Please read the Usage Guidelines.

Adobe Creative Cloud

The MADLab has two workstations with Adobe Creative Cloud!

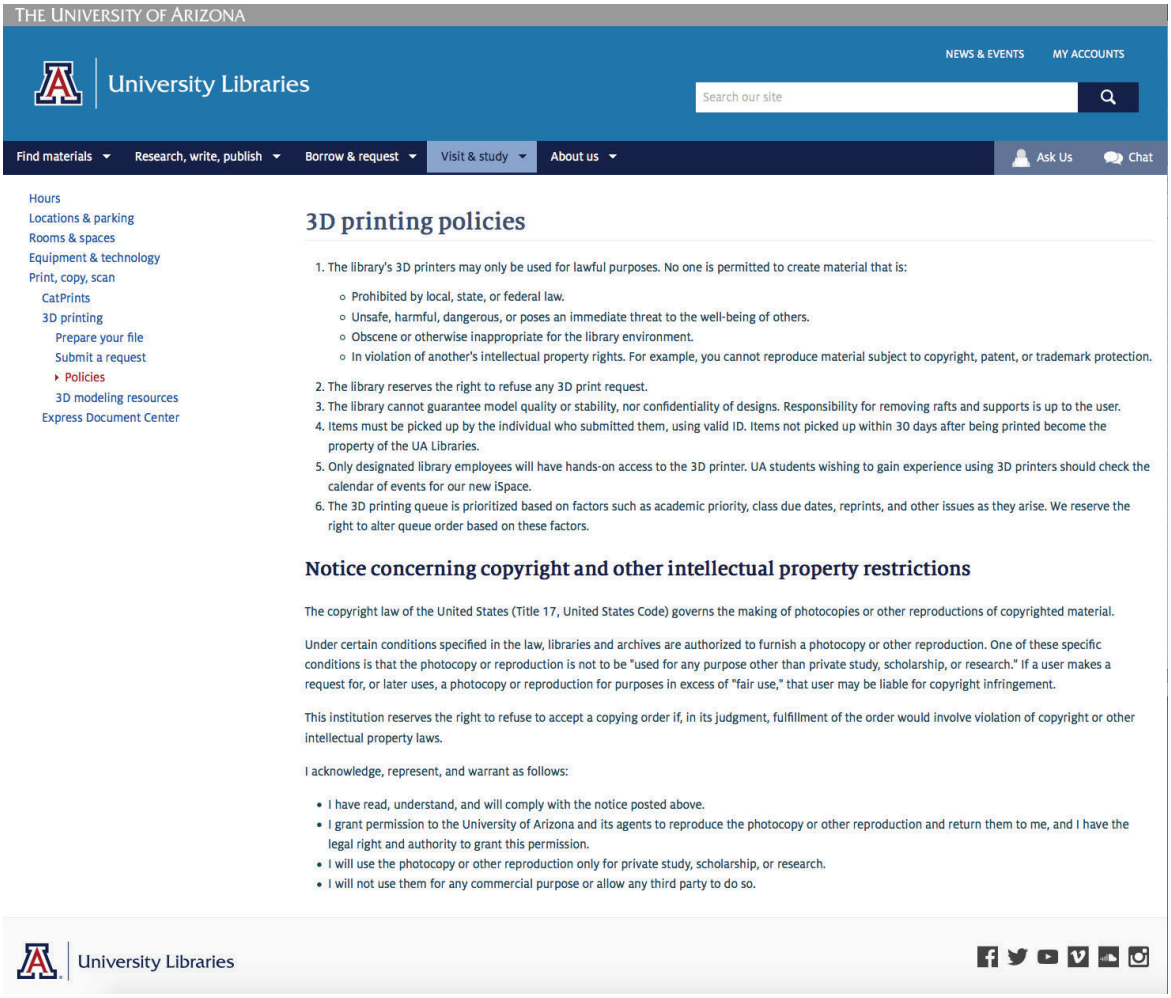
Adobe CC includes Photoshop 3D (including 3D printing functionality), Illustrator and more.

Contact mad.lab@utoronto.ca to book time on the Adobe workstations (no charge).

Find out more about Photoshop and 3D printing here.

Policies and Procedures

UNIVERSITY OF ARIZONA
3D Printing Policies
http://new.library.arizona.edu/visit/print/3D/policies



UNIVERSITY OF ARIZONA
Prepare Your 3D File
http://www.library.arizona.edu/services/print/3D/file

THE UNIVERSITY OF ARIZONA

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  - 3D Printing
  - Prepare Your File
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  - 3D Modeling Resources
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VISIT & STUDY

Prepare Your 3D File

Creating or Editing a Model

You can design your object in any 3D modeling software, such as AutoCAD (free for students and faculty through the UA Software Licensing program). There are also many free software programs available.

You can also use or modify a pre-existing file from a design library.

File Format

Export your model as a stereolithography file, with an STL extension (.stl).

Dimensions

Maximum size is 152 x 152 x 279 mm (6 x 6 x 11 in). Layers must be at least 0.1 mm thick (0.020 in).

Units

We recommend you build your model in millimeters. Or convert to millimeters before submitting the final file.

Resolution

The standard resolution is .2 mm per layer, with 10% infill. You can specify a different quality level by making a note under "Special Instructions" on the submission form.

Multiple Parts

If your model includes multiple parts, make each as a separate STL file. You can submit each model as part of the same print request.

Make a Solid Design

The surface of your 3D model must be watertight. This means all faces of the object must construct one or more closed volume entities. Gaps or holes in the model will cause it to print incorrectly.

See Rhino's How do I Make a Solid Model.

Delete 2D Elements

Your final model should not contain any 2D elements, as they can cause naked edge problems. Delete any 2D elements that were used to create sweeps, lofts, or other complex shapes.

Geometry Check

Check your design for holes, gaps, or other problems before submission. Numerous third party tools can help you fix geometry problems, including:

- NetFabb - provides a cloud base service and free downloadable software that can check you files
- MeshLab - open source software for checking files

Shapeways offers a tutorial for fixing and repairing 3D models using these services.

Common Problems

Other things to be careful of when creating your model:

- degenerate faces - Mesh faces that have 0 area
- zero length edges - Edges with no length, created by degenerate faces
- non manifold edges - Faces that have more than one face connected to a single edge
- naked edges - A surface or polysurface edge that is not connected to another edge
- duplicate faces - Identical faces in a single mesh
- faces should be flipped - The faces in a mesh object should point in a consistent direction
- disjoint pieces - Mesh objects that do not connect but are considered a single mesh

Submitting Your Model

Once your model is ready to go, make a 3D printing request and upload your STL file. We'll contact you within two business days with an estimate for the cost and turnaround time and also let you know if there are any problems with the file.

Last modified: May 14, 2015

University Libraries

BRIGHAM YOUNG UNIVERSITY
3D Printing Guide: Printing Your Design
http://guides.lib.byu.edu/c.php?g=216600&p=1429615

BYU Harold B. Lee Library

Harold B. Lee Library / Subject Guides / 3D Printing Guide / Printing Your Design

3D Printing Guide: Printing Your Design

Enter Search Words | Search

How to utilize the Lee Library's 3D printer. Includes direction on obtaining or designing files for print and the procedures for preparing and sending for print.

Home | Finding Existing 3D Objects | Software and Training | Printing Your Design | Printing Policy | Showcase

Procedure

First, you will need to make sure that your design is in the correct format. We can only accept .stl, .obj, and .thing files. Most 3D design programs will export these file types. Then, bring your file to us at the Science/Maps Help Desk on the 2nd floor of the library. You can bring your file on a flash drive, or you can email it to us at the desk. We will only accept submissions in person. If you just email a file and do not come by and talk to us, your file will not by put in the queue. It is important that you come to the desk so we can go over it with you and make sure that your file will print properly.

Be prepared to specify the dimensions for your design (Remember the maximum dimensions are Length: 11.2 inches, Width: 6.0 inches, Height: 6.1 inches), any special instructions, and the resolution (layer thickness) that you want us to print in. We offer 0.1mm and 0.2mm (Copy paper is about 1.0mm thick).

We will put you on our queue and give you an estimated completion time. When it is finished, we will email you so you can come pick up your final project! Again, the cost is $0.20 for the .02mm. We only accept BYU Signature cards for payment at our desk. If you are not a BYU student or employee, guest printing cards can be obtained at the Circulation Desk.

Other Sources for 3D Printing

Printing for non-academic purposes will be done on a case-by-case basis.

Below are alternatives for printing in the library:

- BYU Rapid Prototyping Lab
- Shapeways
- StarPrototype
- ZoomRP
- MakeXYZ

Subject Guide

Science/Maps Department

Email Me

Contact:
HBLL Level 2
Provo, UT 84602
801-422-2987

Last Updated: Jul 13, 2015 6:08 PM | URL: http://guides.lib.byu.edu/3Dprinting | Print Page | Login to LibApps

Tags: 3-d printing, 3d printer, 3d printing, additive manufacturing, rapid prototyping

GEORGETOWN UNIVERSITY
3D Printing/Scanning | Policies & Submission Form
http://guides.library.georgetown.edu/c.php?g=159780&p=1125920

The Library reserves the right to refuse any 3D print request.

Cost: 3D printing at the Library is currently $.10 a gram of material with a $5.00 set up fee.
Items printed from Library 3D printers that are not picked up within 14 days will not be kept. Items must be picked up by the individual who printed them.
Only designated Gelardin staff will have hands-on access to the 3D printer.

PROCEDURES

The procedure for printing from the Library's 3D printers is as follows:

Design creation:

The 3D printer can be used with basic knowledge of Computer Assisted Drawing (CAD). Creating a new design requires some knowledge of 3D modeling software products.
Any 3D designing software may be used to create a design as long as the file can be saved in .stl, .obj, or .thing file format.
Digital designs also are available from various file-sharing databases such as Thingiverse.com.

Submitting a design for printing:

Georgetown faculty, students, and staff are required to attend a 3D workshop offered by the Gelardin New Media Center or have conducted a consultation with a Mulltimedia Specialist at the Gelardin New Media Center before submitting a 3D printing or scanning submission order.

Persons wanting to have something printed on the 3D printer can bring their file (in .stl, .obj, or .thing file format) (no larger than 25MB) to the Gelardin New Media Center during open hours or email the file to gelardin@georgetown.edu, or email the shared link location in a email to gelardin@georgetown.edu.

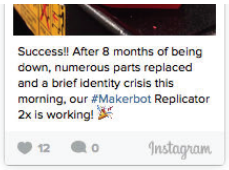
Gelardin staff will add the model to the printing queue.
If there is high demand, the Media Center will give priority to objects being printed for academic purposes.
The files will be readied for printing in MakerWare Desktop software. The Media Center will view all files in MakerWare Desktop.
Wait/pickup time: Items may be picked up at the Gelardin New Media Center. It is sometimes difficult to estimate exact print times.

Please note that procedures governing the use of the Library's 3D printers are subject to change.

DEFINITIONS

3D printing: the process of making a physical object from a digital model.
3D Printer: A 3D printer uses melted plastic to produce objects designed on a computer.
CAD: Computer Assisted Drawing

KENT STATE UNIVERSITY
3D Printing at the SMS | How to Print
http://libguides.library.kent.edu/3d/howto3dprint



- You are also welcome to simply stop in during our open hours for an unscheduled consult, but please be aware that you may be asked to wait several minutes until a consultant is available.

- During the consultation we will:
  - review the file with you in our 3D printer software, checking for noticeable issues/errors, double-checking build size and determining whether your model will require rafts and supports.
  - estimate turnaround time. (1 week minimum from date the file is approved for printing)
  - either approve the file or give it back to you for further adjustment.
- The consultant may offer the option to notify you with a timeframe on when your model will be printed (in case you would like to see it print in person).
- You may not receive an email. This most likely means that your model is approved to print without issues and you will simply be contacted when it is finished.

Pick up model

- You will be notified by email that your model is ready for pickup.
- Return to the SMS in order to retrieve your model and before submitting a new request.

POLICIES

(Revised: August, 2015)

Submissions:

Only submit ONE print request at a time. Additional requests should not be submitted until the previous request is finished and picked up. For multi-part models (that are assembled to create one finished design) please organize the files together into a folder and compress into one zip file for uploading.

File approval:

This 3D printing service is limited to currently enrolled Kent State students. All submissions are subject to approval based on scheduling and availability. Files will be printed in the order that they are approved, not the order that they are submitted. An exception to this would be if we determine that a small print job would fit on the plate with another one in the queue to save time. We also give first priority to print requests for course assignments. Due to the number of requests that we receive each day we are not able to print more than one project per student at a time.

Please note: Our 3D printing service is intended primarily for prototyping 3D designs. We do not offer bulk printing or multiple quantities of individual files unless the pieces are required to assemble into one large model. Each request is subject to evaluation, with special consideration given to course assignments and designed modeled by the student his or herself.

This institution reserves the right to refuse to make available or provide access to photocopy or other reproducing equipment if, in its judgment, use of such equipment would involve violation of copyright, patent or other laws.

We reserve the right to decline any print request for any reason.

Quality:

Items printed may have small surface defects such as bumps or holes. Please also note that while the 3D printers are very accurate, we do not guarantee any precise tolerances on fitting of multi-part objects.

Support material:

Some objects require support material to be printed with them (such as models with large overhangs). Other designs may require a brim (or raft) support at the base of the model. These materials can be easily removed, but you are responsible for removing them. Our SMS consultants will not remove the support material for you.

Course assignments:

If you are an instructor at Kent State who is assigning a project that requires 3D printing we encourage your students to use our services! We recommend contacting SMS Manager **Hilary Kennedy** prior to presenting the assignment to your students so that she can discuss the project with you and offer any tips or factors that your students should keep in mind. That will also help make the process run more smoothly for your class and allow us to complete the printing in a more timely manner. As we progress through the semester, our turnaround time will increase due to the number of classes using our services. *Please allow your students a 2-week minimum on 3D printed assignments.*

FILE SUBMISSIONS

Now through Google Drive

We are now accepting 3D model files for print requests through our **SMS 3D Print Requests** Google Drive folder (replacing our former KSU Dropbox method). To access the folder for the first time, please do the following:

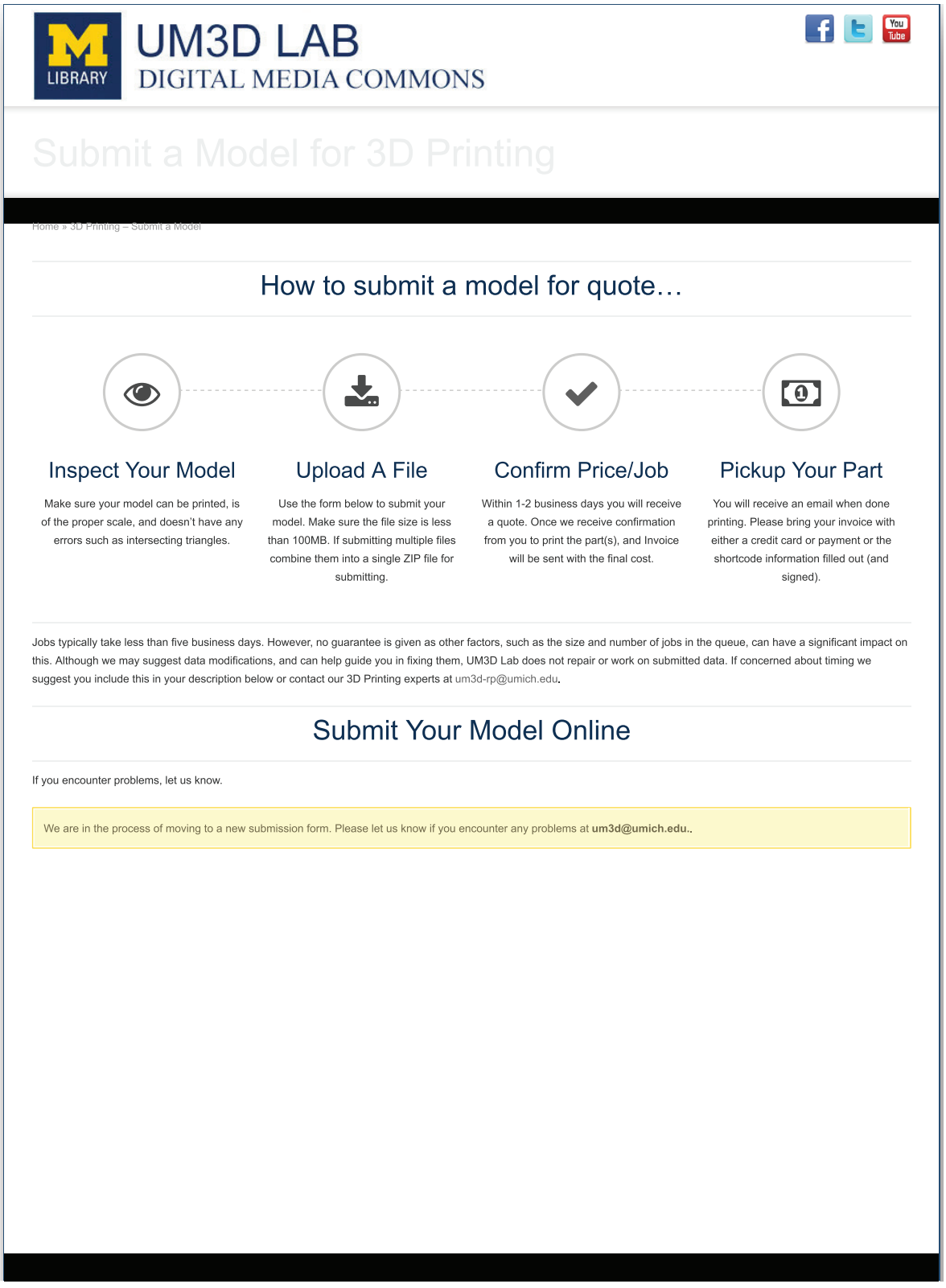
1. Follow the link to the SMS 3D Print Requests folder.
2. Look for a blue button in the top right corner that says, "Sign in" or "Open in Drive". Not signed in yet? Use your Flashline credentials or a personal Google account.
3. Click the "Open in Drive" button. This saves the folder to your Google Drive and immediately directs you to the folder on your drive.
4. Drag and drop the model file from your computer directly into the drive folder.
5. Once your file appears on the page, your task is complete! You will now have quick access to this folder in the future simply by connecting to it directly from your Google Drive account.

Don't forget to fill out the **online form** for your request!

QUESTIONS?

If you have any questions about the process or 3D printing in general, check our **3D Printing FAQs** page or contact us at 330.672.0221. You are also encouraged to visit us in person at the Student Multimedia Studio, located on the first floor of the University Library.

Last Updated: Aug 19, 2015 1:06 PM **URL:** http://libguides.library.kent.edu/3d **Print Page** Login to LibApps
Tags: 3d modeling, 3d printing, student multimedia studio



UM3D LAB
DIGITAL MEDIA COMMONS

Submit a Model for 3D Printing

Home » 3D Printing – Submit a Model

How to submit a model for quote…

Inspect Your Model

Make sure your model can be printed, is of the proper scale, and doesn't have any errors such as intersecting triangles.

Upload A File

Use the form below to submit your model. Make sure the file size is less than 100MB. If submitting multiple files combine them into a single ZIP file for submitting.

Confirm Price/Job

Within 1-2 business days you will receive a quote. Once we receive confirmation from you to print the part(s), and Invoice will be sent with the final cost.

Pickup Your Part

You will receive an email when done printing. Please bring your invoice with either a credit card or payment or the shortcode information filled out (and signed).

Jobs typically take less than five business days. However, no guarantee is given as other factors, such as the size and number of jobs in the queue, can have a significant impact on this. Although we may suggest data modifications, and can help guide you in fixing them, UM3D Lab does not repair or work on submitted data. If concerned about timing we suggest you include this in your description below or contact our 3D Printing experts at um3d-rp@umich.edu.

Submit Your Model Online

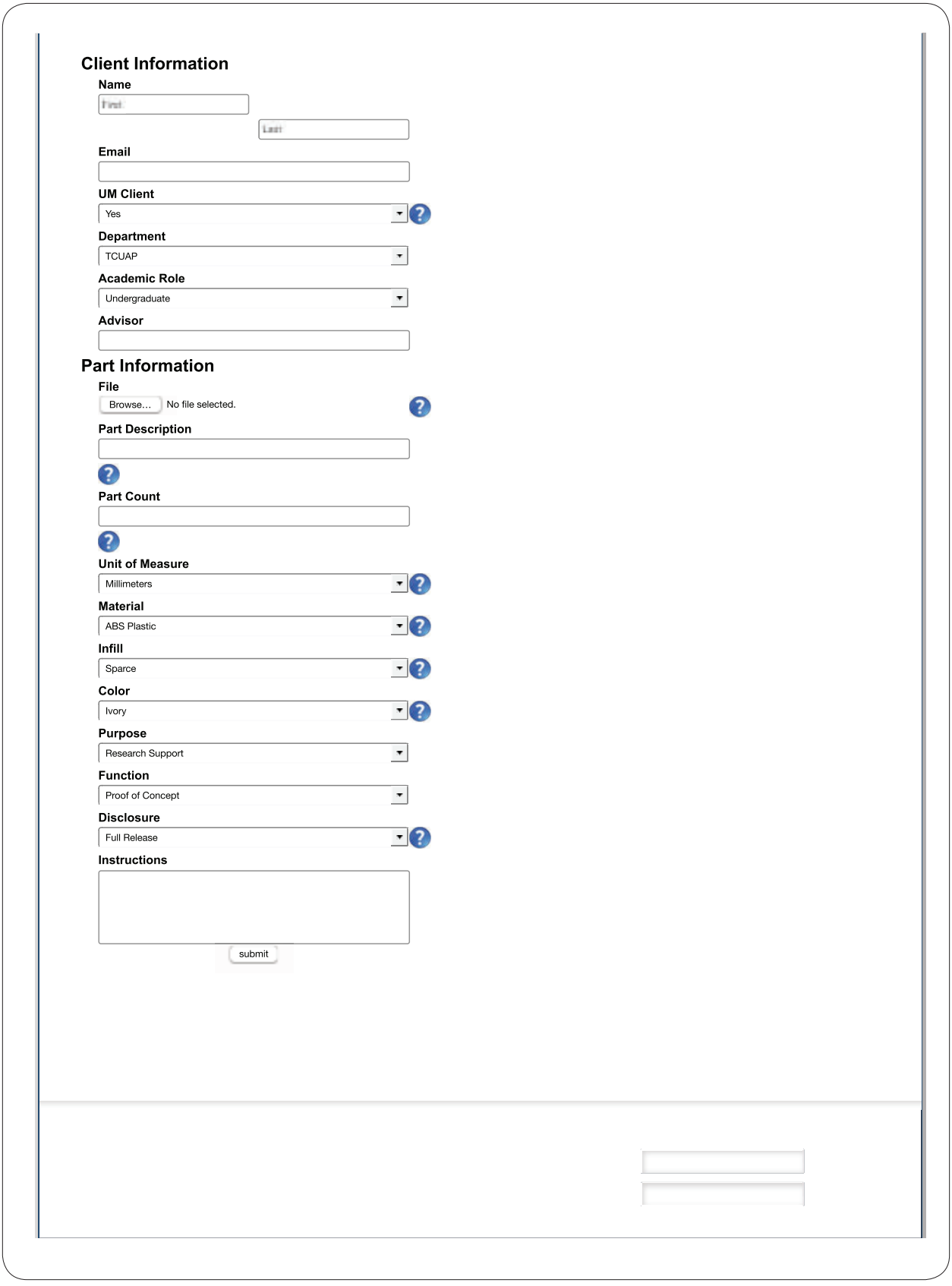
If you encounter problems, let us know.

We are in the process of moving to a new submission form. Please let us know if you encounter any problems at **um3d@umich.edu.**.

UNIVERSITY OF MICHIGAN

UM3D Lab | Submit a Model for 3D Printing

http://um3d.dc.umich.edu/3d-printing-submit-a-model/



Client Information

Name

First

Last

Email

UM Client

Yes

Department

TCUAP

Academic Role

Undergraduate

Advisor

Part Information

File

Browse... No file selected.

Part Description

Part Count

Unit of Measure

Millimeters

Material

ABS Plastic

Infill

Sparce

Color

Ivory

Purpose

Research Support

Function

Proof of Concept

Disclosure

Full Release

Instructions

submit

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Home › Makerspace › FAQ & Policies

FAQ & Policies

Who can use the makerspace?

Our facilities and equipment are open to all current UNC affiliates: Students, Faculty, and Staff.

What equipment & software is in the makerspace?

See our list of what's in the makerspace.

Who can I contact for more information about the makerspace?

Please email us at kenanmakerspace@listserv.unc.edu and one of the librarians who work with the makerspace will respond.

3D Scanning FAQs

Can I use the scanners myself?
Yes, the NextEngine scanner is self-service and the Sense scanner may be checked out. Staff are available to help you learn the process.

What size objects can be scanned?
The NextEngine scanner can handle both very small and fairly large objects. You make a complete object model by combining shots of each facet, each captured from different points of view of your object. Each shot captures an area of your object equal to the field of view. The Macro field is 5.1" x 3.8", and the Wide field is 13.5" x 10.1". HD PRO extends the field to 22.5" x 16.75" at a distance of 30". The Sense scanner has an operatign range of 0.35m to 3m.

How long does it take to scan?
With the NextEngine, each captured view takes about two minutes. A typical object can be fully captured in as little as 12 views. The Sense scanner is very quick and can create an image within a few minutes.

How accurate is the scanner?
In Macro mode, 0.005 inch accuracy, with a maximum of 400 samples (points) per inch. Wide mode provides 0.015 inch accuracy and 150 samples per inch. The Sense has a depth resolution of 1mm at 0.5m.

3D Printing Service Terms of Use

Those utilizing the library's 3D printer must do so for lawful purposes. Users must abide by all applicable laws and policies as stated below, while respecting the health and safety of the University community. Kenan Library staff reserve the right to decline any print request for any reason. The Library cannot guarantee model quality or stability, confidentiality of designs, or specific delivery times.

NOTICE WARNING CONCERNING COPYRIGHT AND OTHER LEGAL RESTRICTIONS.

Copyright law under Title 17 of the United States Code, patent law under Title 35 of the United States Code, and other intellectual

3D Printing FAQs

Is there a cost to use the 3D printer?
For the 2014–2015 academic year 3D printing is funded by the Library Innovation Grant and a grant from the Student Library Advisory Board and there will be no charge for the printing of student projects as long as supplies last. Students are encouraged to contact library staff prior to submission of large print jobs.

How does a 3D printer work?
Our 3D printers render a physical object from a digital model by the process of fused filament fabrication. Plastic filament is fed through a heated nozzle that the computer moves, building layer upon layer from the base of the item upward.

How many 3D printers are available?
Currently Kenan Makerspace houses four MakerBots: the Replicator 2; the Replicator 2X; and two Replicator Minis.

What are the maximum dimensions in which the 3D printers can print?
MakerBot Replicator 2 has a build volume of 11.2 x 6 x 6.1 in.
MakerBot Replicator 2X has a build volume of 9.7 x 6 x 6.1 in.
MakerBot Replicator Mini has a build volume of 3.9 x 3.9 x 4.9 in.

How detailed can the 3D printer get?
The MakerBot can produce layers down to 100 microns (0.0039 in.), but can lose accuracy on larger models.

How long does it take to print an item?
Build times vary depending upon several factors: size, intricacy, amount of support material required, and the number of print requests in the queue. Projects for research and learning purposes will be prioritized. Once your request begins printing, build times typically range from 2 hours to 48 hours each. Print jobs using the soluble supports must be soaked for roughly 24 hours to remove support material. Once the model has been completed, you will be notified via email that it is available for pick up.

Who can submit 3D print requests?
3D printing is availabe to current UNC-CH affiliates. Academic use will be given priority over other projects. Non-academic print requests have no guaranteed turnaround time and are subject to staff approval. Due to the volume of requests, please limit your submissions to one non-academic item per month.

Can I operate a printer myself?
The printers will only be operated directly by staff right now. If you are interested in seeing a 3d printer in action, please contact a staff member for a demonstration.

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This institution reserves the right to refuse to make available or provide access to photocopy or other reproducing equipment if, in its judgment, use of such equipment would involve violation of copyright, patent or other laws.

WEAPON MAKING IS BANNED
Under North Carolina law (N.C. Gen. Stat. § 14-269.2) and University policy, no weapons or life-like replicas are allowed on campus, nor may anyone produce them in the makerspace. This includes parts of weapons, ammunition, and defensive as well as offensive weapons. If you aren't sure what constitutes a weapon, please consult a staff member.

Sewing FAQs

Who can use the sewing machine?
All current UNC Chapel Hill affiliates can use the sewing machine.

What sewing machine is available?
Our machine is a Singer model 9410.

What training is required?
Before using the sewing machine for the first time, you need to read the Standard Operating Procedures (part 1 | part 2). You also need to watch a training video.

When you come to the Makerspace, you'll need to sign a liability waiver.

What material is used by the 3D printer to make the objects?
All three MakerBots use PLA (polylactic acid) bioplastic, which is suitable for moving parts and and functional prototypes. The MakerBot Replicator 2X can also use ABS filament.

What happens if I forget to pick up my model?
Models that are left or not picked up after 1 week may be discarded unless prior arrangements have been made with staff.

Can the printers be used for commercial purposes?
The printers are for non-commercial use only. The printers should not be used to print items that are intended for sale.

Soldering FAQs

Who can use the soldering station?

All current UNC Chapel Hill affiliates can use the station.

What soldering equipment is available?
We have a Hakko-FX888D soldering iron with an exhaust fan.

What training is required?
Before using the soldering station for the first time, you need to read the Standard Operating Procedures. You also need to watch some training videos.

When you come to the Makerspace, you'll need to sign a liability waiver.

SOUTHERN ILLINOIS UNIVERSITY CARBONDALE
3D Printing at Morris Library | Policies & Procedures
http://libguides.lib.siu.edu/content.php?pid=551069&sid=4554902

MORRIS LIBRARY
SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

3D PRINTING AT MORRIS LIBRARY

TAGS: 3D, 3D PRINT, 3D PRINTER, 3D PRINTING, 3D SCANNER, 3D SCANNING, MAKERBOT

A guide to 3D Printing at Morris Library.

3D PRINTING AT MORRIS LIBRARY - PRINTER POLICY

This policy governs 3D printing at Morris Library

What is 3D Printing?

3D printing, or additive manufacturing, is the process of building physical objects from digital models. Successive layers of material (filament) are laid down in thin layers to create a physical object. 3D printing has applications in numerous fields. A listing of some of these applications can be found on the Morris Library 3D printing web page.

What is available at Morris Library?

Currently, Morris Library has a Makerbot Replicator 2 3D Printer. This 3D printer uses 1.75 mm polylactic acid (PLA) filament. PLA is a bioplastic made from renewable resources such as corn starch. Current colors available are listed on Morris Library's 3D printing web page.

The Makerbot Replicator 2 has the following build volume:
28.5 L x 15.3 W x 15.5 H cm (11.2 L x 6.0 W x 6.1 H in)

Additional specifications and information about the Makerbot Replicator 2 can be found at: http://store.makerbot.com/replicator2.

Who can print?

The 3D printer is available for use by all Southern Illinois University students, faculty, and staff. Community members will also be eligible to use the library's 3D printer. Printing is done on a first-come first-served basis taking into account the following priority order: students printing objects for course work, students printing other works, faculty, staff, and then the community.

Terms of Use and Copyright

Those wishing to utilize the library's 3D printer must do so for lawful purposes. Users must abide by all applicable laws, University policies, and library policies while respecting the health and safety of the University community. Morris Library staff reserve the right to decline any print request for any reason.

Southern Illinois University abides by the copyright laws of the United States (Title 17, U.S. Code). These laws govern photocopying or creating other reproductions of copyrighted materials. All users of the 3D printer must abide by copyright laws. For more information, Morris Library has a research guide discussing copyright considerations: http://libguides.lib.siu.edu/copyright.

Cost of 3D printing

Fees for 3D printing at Morris Library are based on a cost-recovery system. Costs are determined by the amount of filament and other materials used during the printing process. After the object is created, it will be weighed. Users will be charged $0.25 per gram rounded up to the nearest gram. There is a minimum cost of $1.00 for any print request. For example, a 1 gram object will cost $1.00 to print (the minimum fee), not $0.25. Upon request, users may wish to print with a more expensive type of filament such as flexible filament. This type of filament is more expensive than regular PLA filament. The cost for this type of filament will be $1.00 per gram. The cost of other types of filament will be determined by library staff.

Users must pay for prints before they will be turned over. Prints will be kept for two weeks. After two weeks, prints will become the property of Morris Library and may be disposed of at that time. Printing may be paid for by cash, check, or credit card. Payment and pick up of prints will be done at the library's Circulation Desk on the first floor of Morris Library.

Refunds will only be given if the printer malfunctions or library staff accidentally break the model. The user is responsible for all errors that occur during printing involving the stereolithographic (.STL) file and design of the model. If the object does not print correctly due to design errors, it is the responsibility of the user to pay for the object. It is recommended that before you submit your .STL file for printing, you utilize a software that checks for errors and helps repair them. One such software is Netfabb. It will help you repair errors

such as bad edges, holes, and reversed normals.

Designing your model for printing

The first step in printing your idea is to design the 3D object using a computer-aided design (CAD) software program. There are numerous open source and free software options to render your digital model including Blender, OpenSCAD, and Sketchup. A more complete listing of these options can be found on the Morris Library 3D printing web page. Users will need to submit their file in .STL file format in order for library staff to convert the file to one that the Makerbot Replicator 2 will read.

If you do not wish to design your own 3D object, there are sources to find models already designed that you may print or alter and then print. Two of these resources are Thingiverse and Yeggi.

File approval

Users must submit their files in .STL format. Users will need to fill out and submit the 3D Printing Request Form along with their .STL file. Library staff will review the file and send a confirmation email to the address provided that the submission has been received. The email will state whether the file has been approved and any important information for the user. Library staff may need additional information about the print job or may need to schedule a consultation with the user. Once the file has been printed, staff will send another email informing the user of the cost of the print and the due date to pick up the model.

If you have several files to print, please submit each of these separately by filling out a separate 3D Printing Request Form for each print.
All submissions are subject to approval based on scheduling and availability. There may be times that the printer is malfunctioning, being repaired, or is being used for an event or a course. During such times, the 3D printer may be unavailable for use and there will be a delay in approving submissions and printing objects. Any significant lapses in printing time will be noted on the 3D printing web page.

After the submission has been printed and the print has been picked up or the two week time limit to pick up the object is over, the submitted file will be deleted by library staff.

If a user wishes to print their object themselves, they will need to schedule an appointment with library staff to receive training on the 3D printer. Users will be supervised by a library staff member during the printing process. The submission form will include this option and a library staff member will contact the user to schedule a training session.

Quality

Users may see slight imperfections in their prints. Small bumps or holes and rough edges at the base of an object may occur with 3D printing. You can clean up some of the imperfections with fine sand paper or other tools. The Makerbot Replicator 2 is very accurate, but there may be some instances where objects do not fit precisely together.

The Makerbot Replicator 2 builds objects from the ground up. There are instances where certain prints will require support material and / or rafts to ensure proper printing. Support material is often needed if the design has large overhangs or parts suspended in mid-air. Rafts are often used as support at the base of the model. These types of additions are easily removable by the user. Staff will not be responsible for removing any supporting material and / or rafts for the user.

Contact

If you would like to meet with a library staff member for additional information about 3D printing or if you have questions, please email Jennifer Horton at jhorton@lib.siu.edu.

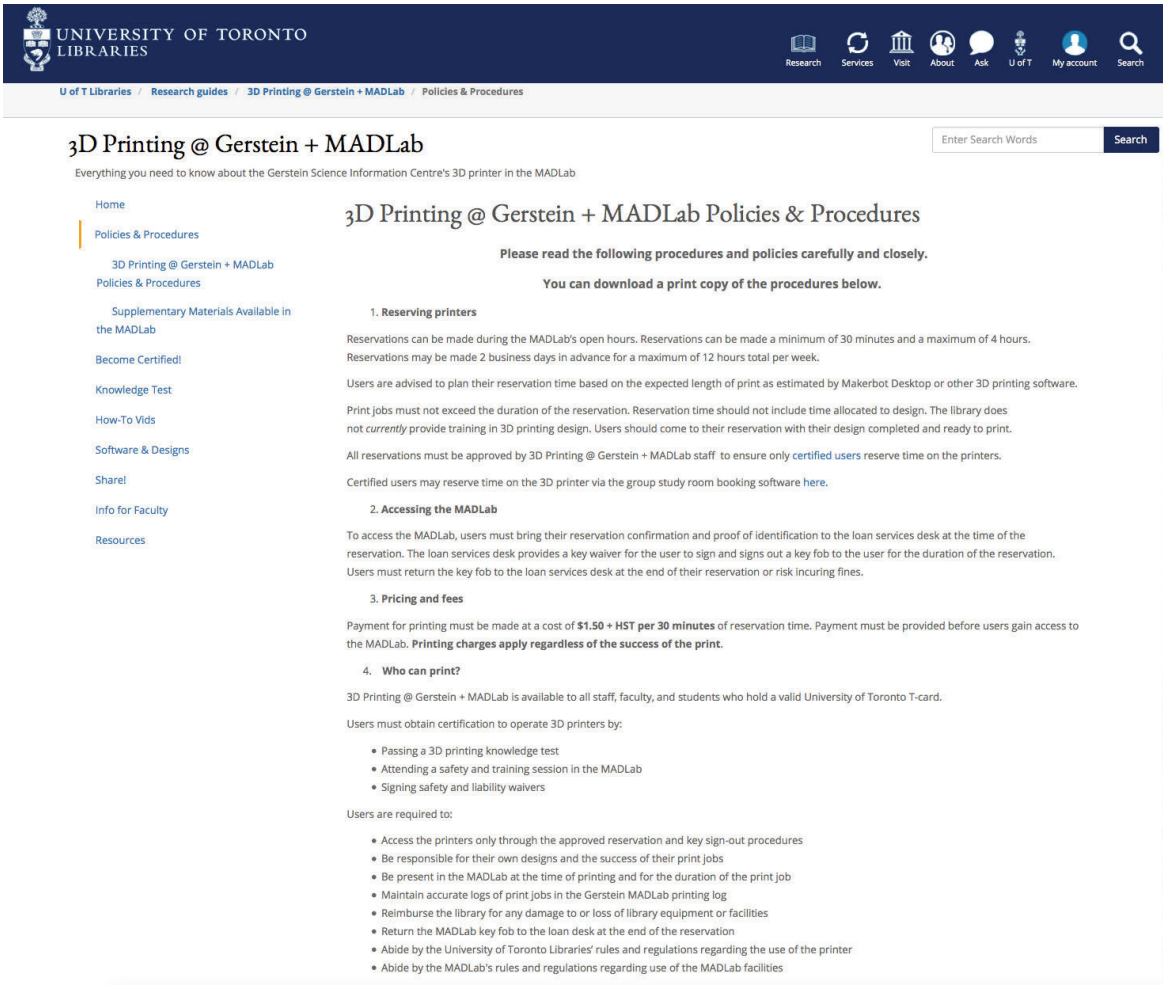
Approved by: Steering Committee, January 16, 2014

Revised by: Steering Committee, August 6, 2015

3D PRINTING AT MORRIS LIBRARY - PRINTER POLICY

Morris Library 3D Printing Policy

UNIVERSITY OF TORONTO
Policies & Procedures
http://guides.library.utoronto.ca/c.php?g=251855&p=1678118



UNIVERSITY OF TORONTO LIBRARIES

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U of T Libraries / Research guides / 3D Printing @ Gerstein + MADLab / Policies & Procedures

3D Printing @ Gerstein + MADLab

Enter Search Words Search

Everything you need to know about the Gerstein Science Information Centre's 3D printer in the MADLab

Home
Policies & Procedures
3D Printing @ Gerstein + MADLab Policies & Procedures
Supplementary Materials Available in the MADLab
Become Certified!
Knowledge Test
How-To Vids
Software & Designs
Share!
Info for Faculty
Resources

3D Printing @ Gerstein + MADLab Policies & Procedures

Please read the following procedures and policies carefully and closely.

You can download a print copy of the procedures below.

1. **Reserving printers**

Reservations can be made during the MADLab's open hours. Reservations can be made a minimum of 30 minutes and a maximum of 4 hours. Reservations may be made 2 business days in advance for a maximum of 12 hours total per week.

Users are advised to plan their reservation time based on the expected length of print as estimated by Makerbot Desktop or other 3D printing software.

Print jobs must not exceed the duration of the reservation. Reservation time should not include time allocated to design. The library does not *currently* provide training in 3D printing design. Users should come to their reservation with their design completed and ready to print.

All reservations must be approved by 3D Printing @ Gerstein + MADLab staff to ensure only certified users reserve time on the printers.

Certified users may reserve time on the 3D printer via the group study room booking software here.

2. **Accessing the MADLab**

To access the MADLab, users must bring their reservation confirmation and proof of identification to the loan services desk at the time of the reservation. The loan services desk provides a key waiver for the user to sign and signs out a key fob to the user for the duration of the reservation. Users must return the key fob to the loan services desk at the end of their reservation or risk incuring fines.

3. **Pricing and fees**

Payment for printing must be made at a cost of **$1.50 + HST per 30 minutes** of reservation time. Payment must be provided before users gain access to the MADLab. **Printing charges apply regardless of the success of the print**.

4. **Who can print?**

3D Printing @ Gerstein + MADLab is available to all staff, faculty, and students who hold a valid University of Toronto T-card.

Users must obtain certification to operate 3D printers by:

- Passing a 3D printing knowledge test
- Attending a safety and training session in the MADLab
- Signing safety and liability waivers

Users are required to:

- Access the printers only through the approved reservation and key sign-out procedures
- Be responsible for their own designs and the success of their print jobs
- Be present in the MADLab at the time of printing and for the duration of the print job
- Maintain accurate logs of print jobs in the Gerstein MADLab printing log
- Reimburse the library for any damage to or loss of library equipment or facilities
- Return the MADLab key fob to the loan desk at the end of the reservation
- Abide by the University of Toronto Libraries' rules and regulations regarding the use of the printer
- Abide by the MADLab's rules and regulations regarding use of the MADLab facilities

Full replacement or repair cost will be charged for lost or damaged equipment.

A $15.00 charge will apply for a lost or non-returned key fob.

5. **Printing policy**

Users must sign a waiver agreeing to follow the University of Toronto Libraries' rules and regulations regarding the use of the printer, and abide to the following:

- There must be no printing of weapons, obscene materials, and other materials that violate the Library's Conduct Regulations (http://onesearch.library.utoronto.ca/conduct-regulations)
- There must be no infringement of any person's intellectual property rights, such as copyright, when using the printer to create a work
- Print jobs must not exceed the duration of the reservation
- Users are responsible for their own designs, and printing charges will apply regardless of the success of the print

6. **Safety regulations**

Users must attend a safety and training session in the MADLab and sign safety and liability waivers upon completion of training. The waivers confirm users' awareness that using the printer may result in risk of personal injury or harm.

Users further agree to abide by the following safety training instructions, and all other safety instructions received from Gerstein Library or MADLab personnel:

- The extrusion print heads are hot during operation (~230 °C) and while cooling down after operation. Never touch the extrusion print heads and always assume the print heads are hot.
- There are multiple moving parts. Always assume the instrument is under operation before attempting to install or remove any printer component or 3D printed objects. Do not attempt to install or remove components/objects from the instrument until you have verified it is not in use.
- Tie back any long hair or baggy clothing.
- Do not attempt to make any mechanical adjustments while the printer is in operation. Additionally, if the instrument locks up or gets "jammed" during the operation, do not attempt to manually move any parts of the instrument.
- When removing an object from the print board with the scraper tool, always scrape away from the body. Keep hands clear of the scraper for safety.

There is a First Aid Kit available on hand for minor cuts and injuries.

- 3D Printing @ Gerstein + MADLab Policies & Procedures

Supplementary Materials Available in the MADLab

- four (4) 2G SD cards
- three (3) scrapers
- lubricant
- 3M painter's tape
- sandpaper
- scissors
- small reference collection of print books related to 3D printing
- first aid kit

Last Updated: Aug 18, 2015 10:01 AM | **URL:** http://guides.library.utoronto.ca/3Dprinting | Print Page | Login to LibApps

User Training

BRIGHAM YOUNG UNIVERSITY
3D Printing Guide: Software and Training
http://guides.lib.byu.edu/c.php?g=216600&p=1429613

BYU Harold B. Lee Library

Harold B. Lee Library / Subject Guides / 3D Printing Guide / Software and Training

3D Printing Guide: Software and Training

Enter Search Words | Search

How to utilize the Lee Library's 3D printer. Includes direction on obtaining or designing files for print and the procedures for preparing and sending for print.

Home | Finding Existing 3D Objects | Software and Training | Printing Your Design | Printing Policy | Showcase

Designing 3D Models

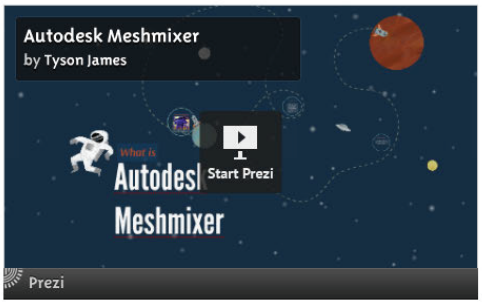
Say you have an idea for a great new bottle opener, or you just sketched a new character for your diorama of the Civil War, or a part broke on your model train and you can't find a replacement. By using some 3D design software, you can render your idea into a 3D model on the computer. If you want to design chess pieces with your family on them, or if you want to custom-build a case for your cell phone, you can do that too!

There are a number of different programs out there and they each offer unique features that may be helpful for you. Some programs are geared towards beginners, while others are more difficult to use, but offer more advanced features. Programs can also differ on their purpose. Some are CAD software that focus on creating precise mechanical drawings, while others are more for creative 3D drawing such as designing action figures or unicorns.

We currently offer Classes in:

1) Printing Preparation:

- Learn how to properly prepare your file to print exactly how you want it. We will go over the entire printing process (design, checks, gcodes, etc) and the limitations of 3d printing. We will be using the software, Meshmixer.



Subject Guide

Science/Maps Department

Email Me

Contact:
HBLL Level 2
Provo, UT 84602
801-422-2987

Free Classes

- Sign Up Now!

Online Tutorials

- 3D Printing Ninja
- 3D Printing Ninja Youtube Channel
- Blender Cookie
- Lynda.com (Through Multimedia Lab)
- 123D Design YouTube Channel

Class Powerpoints

- 3D Printing Prep

- Learn basic CAD (Computer Aided Design) skills to create a 3D drawing. In this class, we will create a bicycle, die, fan, and bracelet. We will go over basic tools such as sketches, dimensioning, extrudes, revolutions, lofts, sweeps, fillets, patterns, and assembly.

3) Blender:

- Learn design skills such as modeling, editing, scupting, rendering, textures, and animation. In these class we will create a mug, iphone case, and sculpt a human head.

4) Adobe:

- Learn to incorporate Illustrator and Photoshop into 3D printing.

- Adobe
- Autodesk Meshmixer
- Autodesk 123D Design: Part 1
- Autodesk 123D Design: Part 2
- Blender : Object and Edit Modes
- Blender: Sculpting
- Blender: Animation & Physics

Class Files

- G-code file
- Blender Background Image
- Inspector Bunny
- Slice
- Non-manifolds
- 3D Printing Curriculum
- Blender Hotkeys

3D Modeling for Printing Class Survey

- Blender Survey
- Autodesk 123D Design

*If you have an FHE group that would like to take a class, please send us an email and we will arrange a private class for your FHE group.

Freeware 3D Design Programs

Here is a list of some FREE common software used in 3D design:

- Autodesk 123D
- Autodesk Inventor
- Blender
- Meshmixer
- Autodesk 123D Catch

Software for Purchase

Here is a list of common software used in 3D design available for purchase:

- Solidworks
- CATIA
- NX
- Zbrush

Print Preparation Programs

To ensure a quality print, it is a good idea to check your model for any errors. These programs will help you find and fix them before you bring it to us.

- Autodesk Meshmixer
- gCode Viewer
- netfabb
- Autodesk Print Utility

Last Updated: Jul 13, 2015 6:08 PM | URL: http://guides.lib.byu.edu/3Dprinting | Print Page | Login to LibApps

Tags: 3-d printing, 3d printer, 3d printing, additive manufacturing, rapid prototyping

learn more & RSVP at library.georgetown.edu/events

3D PRINTING DEMONSTRATIONS FOR FACULTY

Math & Science: February 24, 351 Regents Hall

Humanities & Social Sciences: March 3, McGhee Library, ICC

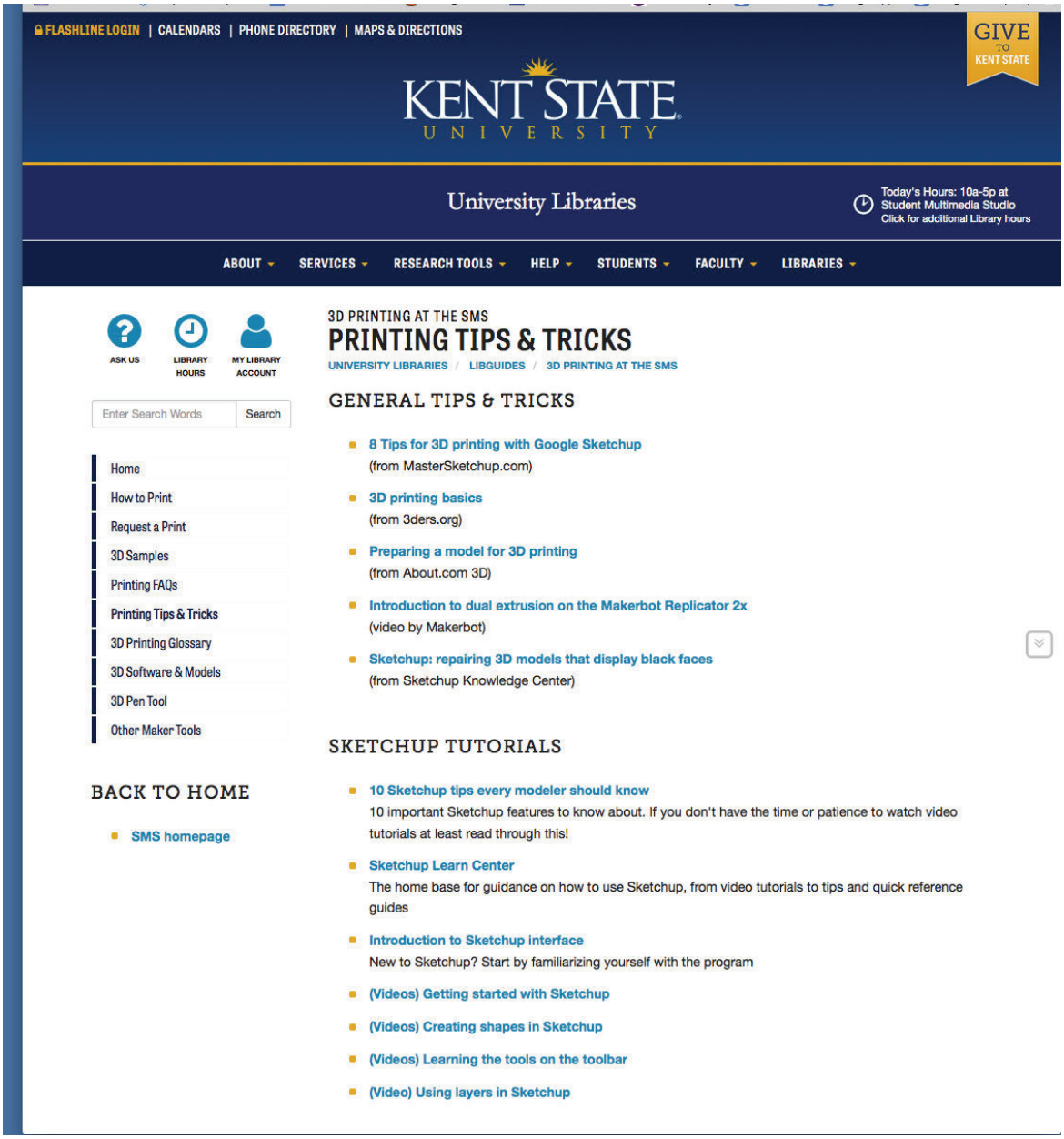
Business & Economics: March 17, 360 Hariri Building

International Affairs: March 24, McGhee Library, ICC

all sessions are 2 PM-3:30 PM ⬡ open to all interested faculty

GEORGETOWN UNIVERSITY LIBRARY

KENT STATE UNIVERSITY
3D Printing at the SMS | Printing Tips & Tricks
http://libguides.library.kent.edu/3d/3dtips



TINKERCAD TUTORIALS

- **Keyboard shortcuts for the Tinkercad Editor**
  (from the Tinkercad blog)
- **Tinkercad Quests**
  Interactive tutorials from Tinkercad to introduce users to the editing tool
- **Heard rumors that Tinkercad was going away?**
  If you've done searches on Tinkercad you may have seem articles stating that Tinkercad was no longer being developed and would soon disappear completely. Fear not - Autodesk bought Tinkercad! Read on for details.
- **How to 3D print a vector file using Tinkercad**
  (from instructables.com)

RHINO TIPS & TRICKS

- **Model preparation in Rhino**
  (from Williamette University) important aspects of your model to review before having it 3D printed

We do not currently have Rhino on our machines in the SMS so unfortunately we are not able to provide much instructional support. However, here are a few resources that may be of use to Rhino users.

- **Rhino - tutorials**
  (from Rhinoceros)

ONLINE 3D MODELING COMMUNITIES

- **Thingiverse**
  from Makerbot - a place to share and download free printable 3D model designs
- **Smithsonian X 3D**
  The Smithsonian is in process of digitizing its collection in 3D and offers free, downloadable model files
- **Sketchfab**
  Online community for publishing and browsing 3D models - some offer the option to download
- **YouMagine.com**
  a file-sharing 3D printing community with a built-in web-based 3d modeling tool
- **My Mini Factory**
  Downloadable 3D models (some free); sign up for a free account to earn free credits toward downloads; upload your own designs to earn more credits (and can even charge for your models)
- **Shapeways**
  Make, buy and sell 3D printed products
- **Ponoko**
  Make, share, buy or sell 3D product designs

LIBRARY

UM3D LAB
DIGITAL MEDIA COMMONS

Walk Up - Cube 2

Home » Cube 2

The UM3D Lab offers a wide range of Additive Manufacturing and 3D Printing technologies to help you create physical versions of your digital creations. We want to provide you the technology and support needed for you to do what you do best, come up with great ideas and novel uses.

As part of our service we have a collection of walk-up Cube 2 printers which give you the opportunity to get your hands dirty and print designs yourself. These printers are currently located in the Duderstadt Center just past the 1st floor info desk. All you need to get started is a material cartridge, an STL file, and registration into the reservation system. Below is a list of tutorials to get started, some helpful links for reserving time on the printers, and generally how to get started.

General hours for support in the UM3D Lab are: **Monday-Friday**: 9am-6pm

3D Printer Cluster

Steps to 3D Printing on the Cube 2:

1. Learn to Operate the Machine

Review the how-to videos below. They're short and show you how to use the printers so your part comes out correctly (and the machine survives the process). You will need this information to pass the knowledge test.

Watch Cube Tutorial Videos
Frequently Asked Questions

2. Get Access to the Printers

To be able to reserve the printers we need to know you understand how the printers operate and how to print a part. Take a basic knowledge test showing you understand what's in the videos.

Take the Knowledge Test

3. Reserve a 3D Printer

Once you've been added to the system (you will receive an email), you can reserve time on a printer through the Event Management System (EMS) reservation system. Once you've reserved a time block you can then get a key from the info desk **during your reserved time.**

Learning to Reserve Time
Open the EMS System

4. Print Your Creation

To fabricate your part you will need a **PLA** material cartridge **(NO ABS)**, and a USB memory stick containing your Cube file. It may take a couple tries to have a successful print, but once you get the hang of it you will be on your way! Be sure to order **PLA material only** as **ABS is not permitted** on MLibrary Cubes.

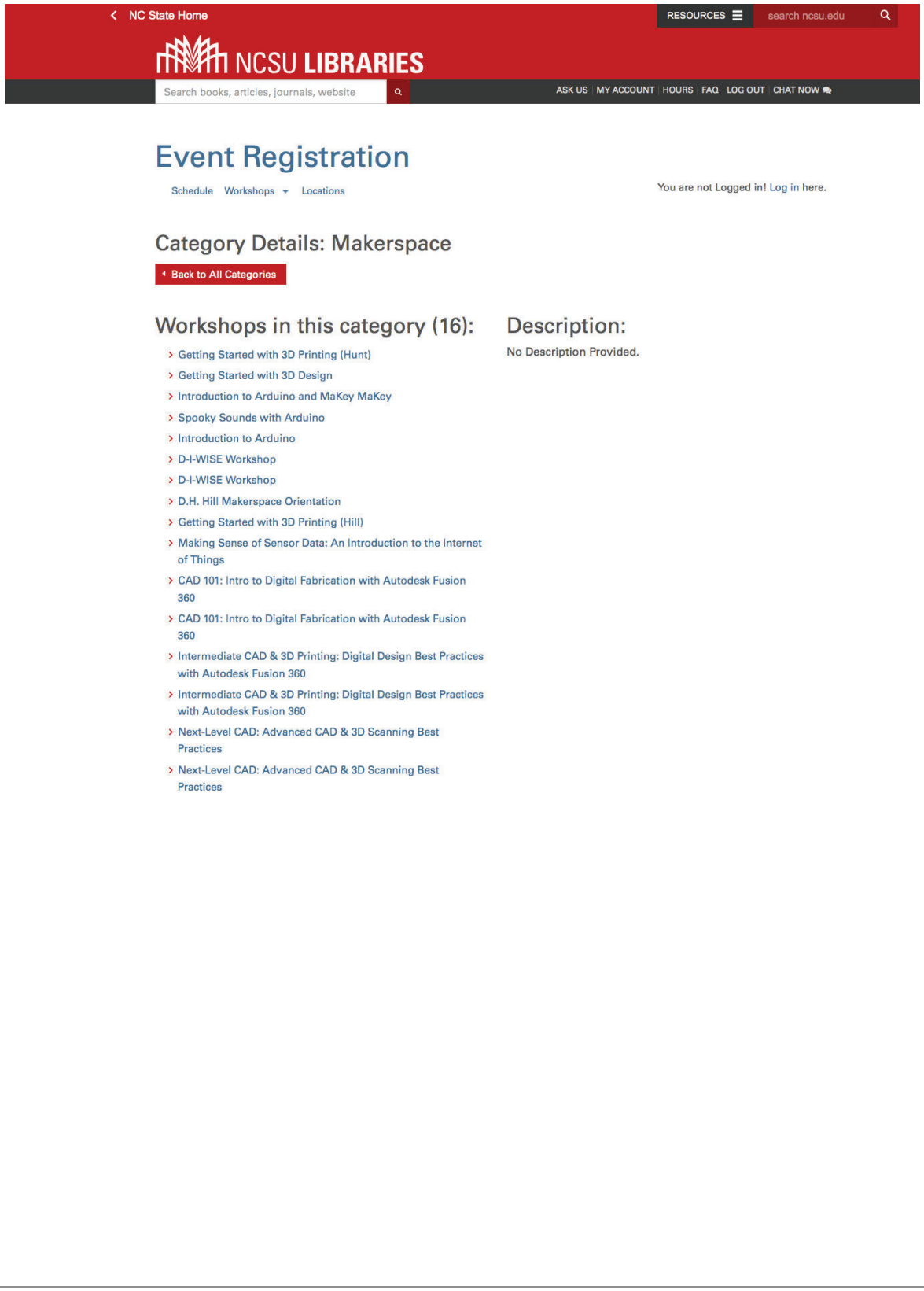
Order Your Own Materials
Download the Software

5. Final Cleanup

Please return the Cube to the state that you found it in. Remove your part, clean the print plate, toss any waste, return checkout items, and don't forget to take your USB memory stick.

Provide Us Feedback

NORTH CAROLINA STATE UNIVERSITY
Event Registration
https://www.lib.ncsu.edu/events/registration/workshop/category/details/categoryId/4



PURDUE UNIVERSITY
3D Printing: Tutorials
http://guides.lib.purdue.edu/3dprinting/tutorials

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Hours | My Account | Ask a Librarian | Course Reserves | Interlibrary Loan (ILL) | Libraries Directory | Give to the Libraries

Library Guides / 3D Printing / Tutorials

3D Printing: Tutorials

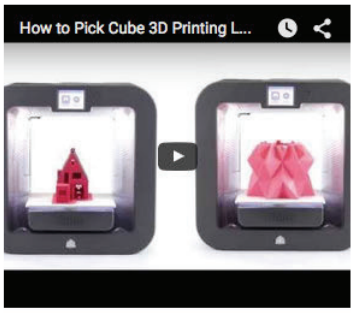
Enter Search Words | Search

This guide will assist patrons who plan to use the 3D printing available in the Engineering Library.

Home | Software | Tutorials | FAQ | 3D Scanning

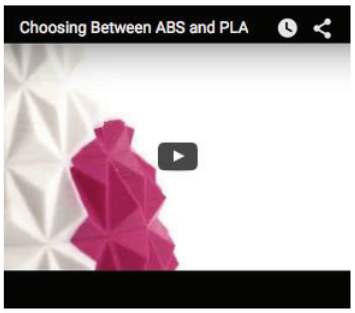
Decisions in Your 3D Print

- **Layer Resolution**



  - This video explains the differences in layer resolution options in the Cubify software. Layer resolution determines the thickness or thinness of your 3D print. Your options are 70 microns & 200 microns. 70 microns are for small, very detailed designs. This layer resolution does take more time in printing. Whereas the 200 microns layer resolution is prefered with larger, little-detailed designs, and prints much faster with less layers.

- **ABS or PLA Material**



  - After you've created your design, you can decide between two different printing materials; ABS or PLA. It's important to know that each material has its own qualities and characteristics, which can be an advanatge or disadvantage to your 3D Print. ABS is a softer, maluable plastic with a tendacy to warp. PLA is a recycled plastic with a glossier finish, but can be a bit more fragile.

- **Color Options**
  - The ENGR Library 3D Printer has the following colors to choose from. Even though you do have the option to create two-color 3D prints, we discourage it. Two-color prints are more expensive and require more time in printing. If you absolutely need a two-color print, **consult with the engineering library staff** first.

ABS Color Options	
PLA Color Options	

Using The Cube

A variety of tutorials via Cubify on how to manage the Cube 3.

- About the Cube 3
  A brief video highlighting the best features of the Cube 3.
- Cube First Print
  A basic introduction to using the Cube 3 for the first time, including basics about the Cube 3 software.
- Two-color Printing
  Information about printing with two colors.
- Auto Level and Auto Gap
  An explanation of how the auto level and auto gap features work on the Cube 3.
- Cartridge Change
  A brief demonstration of how to change the cartridges.

Designing 3D Models

- AutoCAD
  Essential training tutorial of AutoCAD'S 2016 program.

Below are a few Lynda.com tutorials on how to use different 3D design software programs. Refer back to the software section for available programs and the links to download them.

- TinkerCAD
  Designing replacement parts using basic tools on TinkerCAD.
- Blender
  An overview of modeling 3D designs in Blender 2.6.
- SketchUp Make
  A tutorial in navigating, drawing in 2D and 3D space, and designing ideas in SketchUp Make.
- OpenSCAD
  Creating a captive sphere using OpenSCAD's text instructions.

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3D Printing at Morris Library | Resources
http://libguides.lib.siu.edu/content.php?pid=551069&sid=4555728

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TAGS: 3D, 3D PRINT, 3D PRINTER, 3D PRINTING, 3D SCANNER, 3D SCANNING, MAKERBOT

A guide to 3D Printing at Morris Library.

Last Updated: Aug 17, 2015 | URL: http://libguides.lib.siu.edu/3d | Print Guide | RSS Updates | Email Alerts

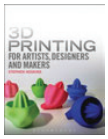
Home | 3D Modeling Software & Free Models | Request a Print | Examples printed at Morris | Policies & Procedures | Resources
3D Printing Terms | Previous Tips of the Week | Virtual Exhibits Information

Resources | Print Page | Search: This Guide Search

BOOKS

Fabricated - Hod Lipson; Melba Kurman
Call Number: Z249.3 .L57 2013x
ISBN: 9781118350638
Publication Date: 2013-02-11

3D Printing - Christopher Barnatt
Call Number: TS171.8 .B37 2013x
ISBN: 9781484181768
Publication Date: 2013-05-04



3D Printing for Artists, Designers and Makers - Stephen Hoskins
Call Number: TS171.4 .H67 2013x
ISBN: 9781408173794
Publication Date: 2014-01-02

Makers - Chris Anderson
Call Number: HB615 .A683 2012x
ISBN: 9780307720962

TUTORIALS

- Autodesk 123D Design Tutorials
- MasterSketchup.com
- Blender Tutorials
- Blender 3D Design Course
- Netfabb Studio Video Tutorials
- Makerbot's OpenSCAD Tutorial

3D PRINTING BLOGS

- 3D Printing Industry
- 3DPrint
- Makerbot Blog
- Fabbaloo
- 3ders
- Makerhome

3D PRINTING NEWS

- 3D Printing Will Change Auto Industry, From Manufacturers to Dealers - Ward's Auto
- ORNL & Clayton Homes are 3D Printing a Home & Car That Share Energy with One ... - 3DPrint.com
- 3D printing can revolutionise emergency healthcare - SciDev.Net
- InterLatin Continues Success in 3D Market with Constructor 3D Printing Software - 3DPrint.com
- 3D Printing Dog 'Helps' Creates These One-piece Fully Assembled Kinetic Sculptures - 3DPrint.com

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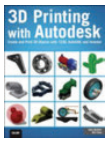
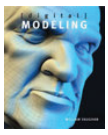
OBJECT REPOSITORIES / COMMUNITIES

- **Thingiverse**
  Thingiverse is a community to discover, make, and share 3D models. Users can download files of objects that others have made. Several of the objects can be customized and modified.
- **Yeggi**
  Yeggi is a search engine to find 3D printable objects.
- **Repables**
  Open repository of digital files suitable for 3D printing.
- **Sketchup 3D Warehouse**
  Sketchup's design library of 3D models.
- **Smithsonian X3D**
  Collection of 3D models of various artifacts from the Smithsonian Museums.
- **NIH 3D Print Exchange**
  Search, browse, download, and share 3D biomedical printable models including custom labware.
- **NASA 3D Resources (Beta)**
  NASA's 3D resources site that includes several printable models in .STL

3D MODELING BOOKS



3D Printing with Autodesk - John Biehler; Bill Fane
Call Number: TS171.8 .B54 2014
ISBN: 9780789753281
Publication Date: 2014-05-14



Digital Modeling - George Maestri; William Vaughan
Call Number: T385 .V38 2012x
ISBN: 9780321700896
Publication Date: 2011-12-23

Beginner Blender - Lance Flavell
ISBN: 9781430231271
Publication Date: 2010-01-01

Publication Date: 2014-04-08

Printing Things - Claire Warnier; Dries Verbruggen; S. Ehmann (Editor); R. Klanten (Editor)
Call Number: TS171.8 .P75 2014x
ISBN: 9783899555165
Publication Date: 2014-05-22

Make - 3D Printing - Anna Kaziunas France (Editor)
ISBN: 9781457182938
Publication Date: 2013-12-13

Blender Master Class - Ben Simonds
ISBN: 9781593274771
Publication Date: 2013-03-03

Autodesk Inventor 2014 and Inventor LT 2014 - Thom Tremblay
Call Number: T385 .T74 2013x
ISBN: 9781118575208
Publication Date: 2013-07-22

format.

- **British Geological Survey**
  Site contains many 3D models of fossils. You can download an OBJ file to use in 3D printing.
- **AfricanFossils.org**
  Africanfossils.org has several 3D models of significant fossils and artifacts in categories such as hominids, animals, and tools. It is a partnership with Autodesk, National Geographic, the Turkana Basin Institute, the National Museum of Kenya, and Stony Brook University.
- **The Collection - Art & Archaeology Museum**
  3D Scan project by artist Oliver Laric at The Usher Gallery at The Collection in Lincolnshire, UK.
- **The Virtual Hamspon Museum**
  3D scans of Native American artifacts from the Hampson Archeological Museum State Park in Wilson, Arkansas. OBJ files are included.

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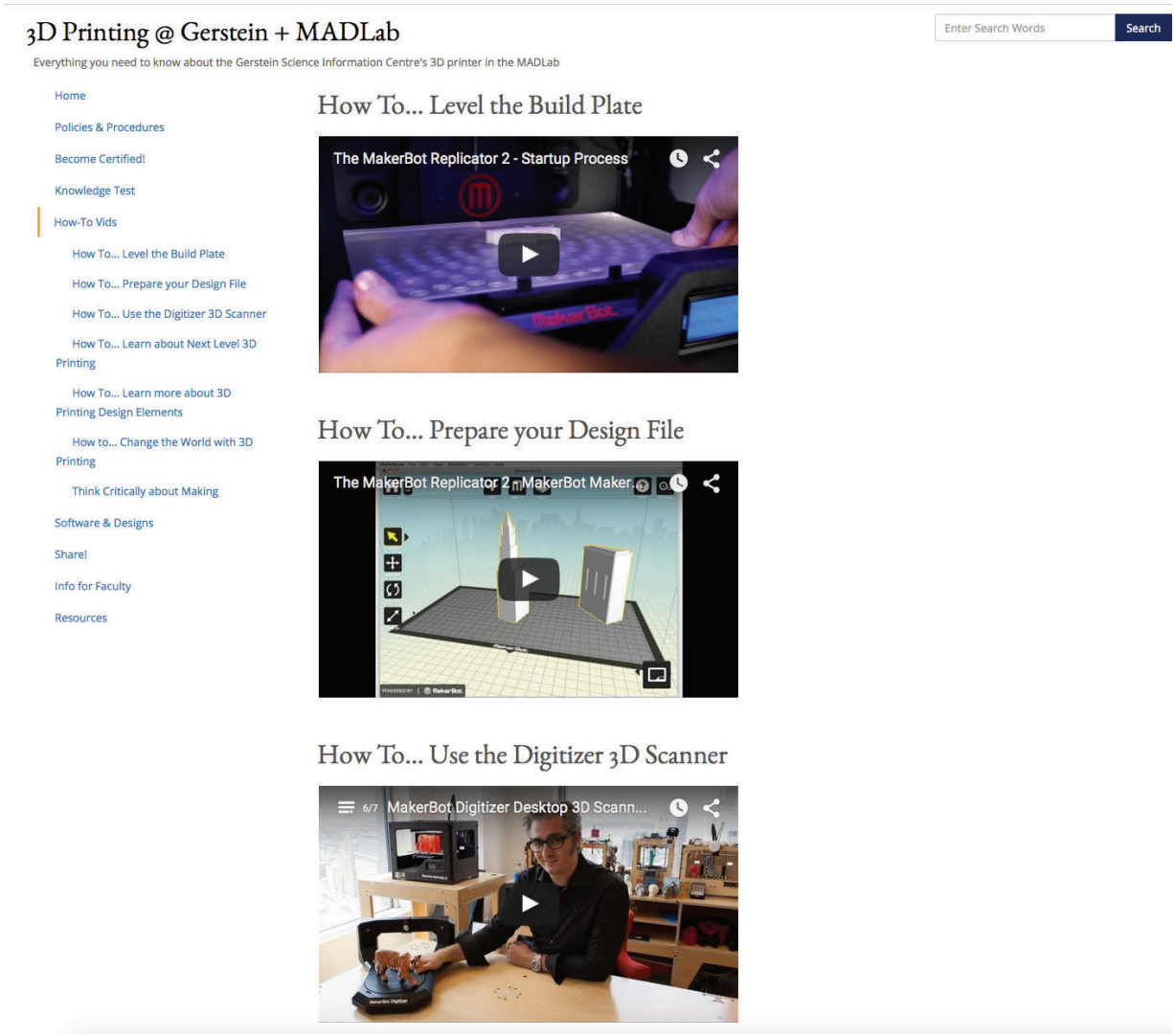

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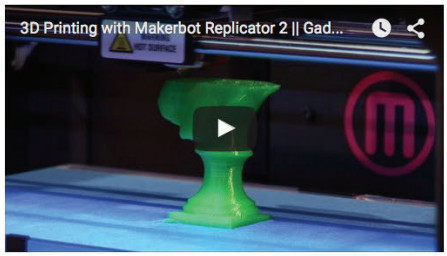
How To... Learn about Next Level 3D Printing

Watch Toronto's resident 3D Printing expert, Derek Quenneville, show off objects and design elements created by 3D printers more powerful than our own Makerbot Replicator 2s.

How To... Learn more about 3D Printing Design Elements



How to... Change the World with 3D Printing

Watch the inspiring videos below to see how 3D printing is changing lives with patience, spirit, and a desktop 3D printer.

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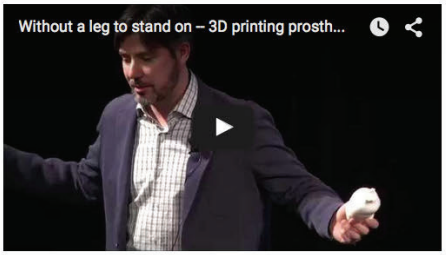

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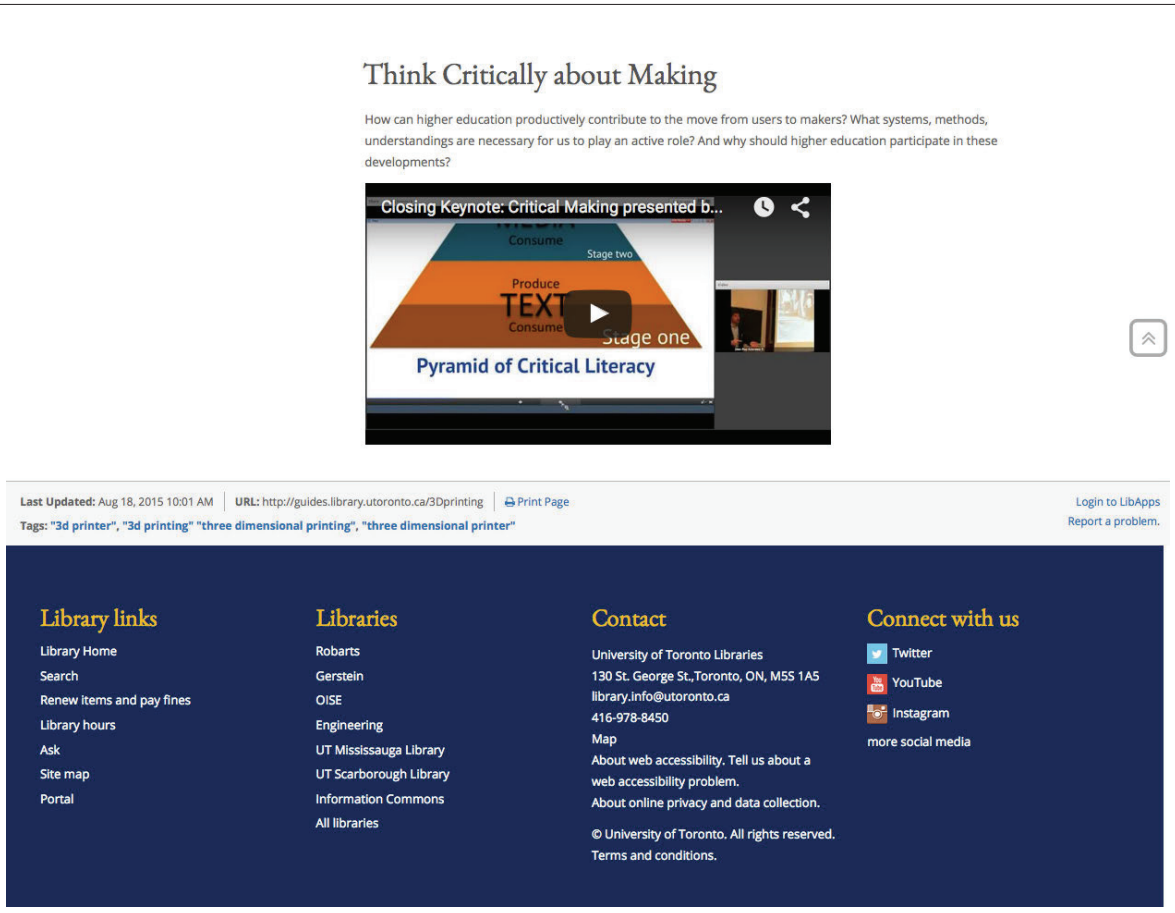

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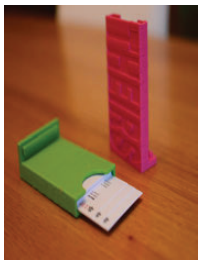
Featured Print



Want to up your networking game and show off your 3D printing skills? Organize your business cards and collected cards with these dual card holders on Thingiverse. More job-hunting designs on the blog!

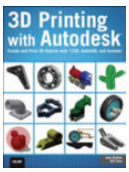
3D Printing Collection @ The MADLab

Getting Started with MakerBot by Bre Pettis; Anna Kaziunas France; Jay Shergill
ISBN: 1449338658

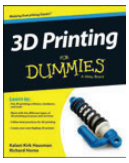
Makers: The new industrial revolution by Chris Anderson

Makers by Cory Doctorow

Fabricated by Hod Lipson; Melba Kurman



3D Printing with Autodesk by John Biehler; Bill Fane

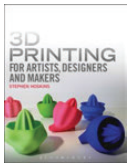


3D Printing for Dummies by Kalani Kirk Hausman; Richard Horne

Make: Ultimate Guide to 3D Printing 2014 by Mark Frauenfelder (Editor)

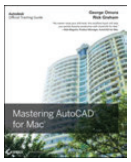
DIY Citizenship by Matt Ratto (Editor); Megan Boler (Editor)

More 3D Printing Resources at UTL

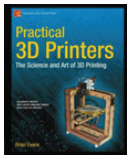


3D Printing for Artists, Designers and Makers by Stephen Hoskins

Beginning Google Sketchup for 3D Printing by Sandeep Singh



Mastering AutoCAD for Mac by George Omura; Richard (Rick) Graham



Practical 3D Printers by Brian Evans

The

3D Printing & Making Websites

- Adafruit Industries
  Tutorials, community forums, and an online shop for makers and 3D printers. Also view their extensiv YouTube channel!
- Instructables 123D group
  Instructions for designing creative prints using Autodesk 123D Design.
- MAKE Magazine
  Online resources for videos, how-tos, blog posts, and more on a wide range of maker projects.
- MakerSpace
  MAKE Magazine's online community for makers.
- Shapeways
  Sell 3D printed products in Shapeways' online marketplace.
- The Art of 3D Print Failure Flickr Group
  A community for sharing epic fails and learning from mistakes.
- YouMagazine
  An online community of 3D print enthusiasts and tinkerers for sharing ideas.

3D Printing & Making Blogs

- 3D Printing Industry
  News and reports on new developments in 3D printing.
- 3Digital Cooks
  A blog all about experimental 3D food printing.
- James Madison University 3-SPACE
  JMU students in 3D printing courses blog about what they've learned and applications of 3D printing i their future careers.
- Law in the Making
  The 3D printing law blog. All about copyright, patents and other legal issues.
- MakerBot Blog
  The company's blog featuring tips, updates, and cool projects.
- RepRap Magazine
  Free online magazine including reviews, interviews, and news about 3D printing.
- Tales of a 3D Printer
  A middle school Maker Club blogs about their adventures in 3D printing.
- Textile Messages
  Blog of The Creativity Labs at Indiana University Bloomington. Posts on wearable tech, maker culture, and learning and technology.

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Toronto 3D Printing Services & Maker Communities

- University of Toronto Faculty of Applied Science & Engineering - Entrepreneurship Hatchery 3D Printing Service
  After you apply for the 3D printing service and submit your STL file, one of the Hatchery connectors will contact you about all the specifics we need to know for the printing.
- 3D Hubs in Toronto
  Find makers in your community who will print your designs for a fee.
- 3Dphacktory
  A full-service 3D printing and design studio located downtown.
- Critical Making Lab
  Website of the University of Toronto's Critical Making Lab, including workshops and info about their projects.
- Hacklab.to
  A collective of computer programmers, web designers, and hardware hackers. The group runs a blog and meets on Tuesday nights.
- Hot Pop Factory
  A 3D design and printing studio, offering printing services and consultations for client projects.
- MakeLab
  A manufacturing studio for makers and businesses. Also run classes and events.
- MakerKids
  Programs for kids and training for adults in their Dundas West makerspace.
- Toronto MakerFaire
  A two-day festival for makers to show off and share their projects and expertise.

Last Updated: Aug 18, 2015 10:01 AM | **URL:** http://guides.library.utoronto.ca/3Dprinting | Print Page
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http://scholarslab.org/experimental-humanities/spring-2015-makerspace-workshops/

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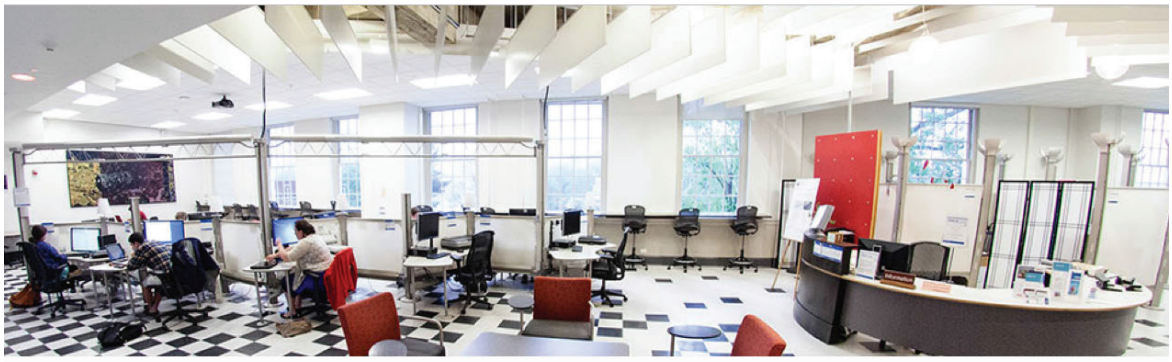


Spring 2015 Makerspace Workshops

By Laura Miller · January 21, 2015

Introduction to Omeka
Wednesday, January 28
10:00 am–11:30 am · Alderman Library, Room 421
Omeka is a simple, free, web publishing system developed at the Roy Rosensweig Center for History and New Media at George Mason University. It was specifically built to enable scholars, archives, libraries, museums, and independent researchers to create online exhibits of their work without having to know HTML or CSS. If you have a collections of digital resources that you want to show in a scholarly way, Omeka could be a great tool to have in your toolkit.
Instructor: Ronda Grizzle

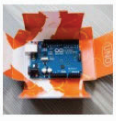
omeka

Introduction to 3D Printing
Thursday, January 29
2:00 pm–3:30 pm · Alderman Library, Room 421
This workshop will introduce participants to the exciting world of desktop fabrication. We'll provide a brief overview of current trends and tools for 3D modeling and printing. We'll also go over the basics of model creation with photogrammetry, and discuss how 3D printing works, including a live demonstration with one of our Makerbots.
Instructor: Jeremy Boggs

Working with Arduino I
Thursday, February 5
2:00 pm–3:30 pm · Alderman Library, Room 421
Do you want to hack your personal items with switches or sensors? Arduino is a tool for making microcomputers that can sense and control the physical world. This workshop will introduce participants to the basics of physical computing programming through a series of hands-on exercises using our Arduino kits. No electronics experience required!
Instructor: Jeremy Boggs

Introduction to Neatline
Wednesday, February 11
10:00 am – 11:30 am · Alderman Library, Room 421
Using Neatline, anyone can create beautiful, interactive maps, timelines, and narrative sequences from collections of archives and artifacts, telling scholarly stories in a whole new way. Join us for this hands-on introduction. See http://neatline.org/ for more information.
Instructor: Ronda Grizzle

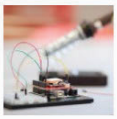
Working with Arduino II
Thursday, February 12
2:00 pm–3:30 pm · Alderman Library, Room 421
New to microcontrollers? Or used an Arduino before and want more time to play in a supportive environment? Come on by! Arduino is a tool for making microcomputers that can sense and control the physical world. This workshop will introduce participants to the basics of physical computing and programming through a series of hands-on exercises using our Arduino kits. This workshop builds on the Working with Arduino I workshop, but it's not required to attend this one.
Instructor: Jeremy Boggs



HTML for Beginners
Thursday, February 19
2:00-3:30 pm · Alderman Library, Room 421
Wonder how websites work? Want to get started creating web content of your own, but have no idea how to do that? This is the class for you. We'll cover everything from how URLs work to basic HTML coding skills to general netiquette. This workshop is intended for absolute beginners with no knowledge of HTML.
Instructor: Ronda Grizzle

Intro to Wearables and Soft Circuits
Wednesday, February 25 [THIS EVENT HAS BEEN RESCHEDULED FOR **MARCH 18 at 10:00 AM**]
10:00-11:30 am · Alderman Library, Room 421
Have ideas to make your life simpler with hacks for your outerwear or accessories? This beginner workshop will introduce the basics of circuity and give an overview of current trends in wearable computing. Participants will make their own circuit using LED's and conductive thread. Materials will be provided and no experience with sewing or electronics is necessary.
Instructors: Jeremy Boggs and Purdom Lindblad

Working with Arduino III
Thursday, February 26
2:00 pm–3:30 pm · Alderman Library, Room 421
New to microcontrollers? Or used an Arduino before and want more time to play in a supportive environment? Come on by! Arduino is a tool for making microcomputers that can sense and control the physical world. This workshop will introduce participants to the basics of physical computing and programming through a series of hands-on exercises using our Arduino kits. This workshop builds on the Working with Arduino I and II workshops, but they're not required to attend this one.
Instructor: Jeremy Boggs



Introduction to 3D Printing
Thursday, March 5
2:00 pm–3:30 pm · Alderman Library, Room 421
This workshop will introduce participants to the exciting world of desktop fabrication. We'll provide a brief overview of current trends and tools for 3D modeling and printing. We'll also go over the basics of model creation with photogrammetry, and discuss how 3D printing works, including a live demonstration with one of our Makerbots. This course is a repeat of the Jan. 29 session.
Instructor: Shane Lin

Scholars' Lab workshops assume attendees have no previous experience. They will be hands-on with with expert assistance. All are free to attend, and they are open to the UVa and larger Charlottesville community.

Job Descriptions

UNIVERSITY OF CALGARY

Job Profile

UCPL Number:
Job Title: **Digital Media Commons (Student) Assistant**
Date: **April 16, 2012**
Faculty/Admin Area: **Libraries and Cultural Resources**
Department/Unit: **Digital Media Commons**
Job Family *(if known)*: **OPA**
Development Phase (*if known*)**: Phase I**

Nature of the Work (*To whom position reports, complexity and amount of work/peak periods, other conditions: eg shift work, callout, dangerous or stressful conditions etc*)**:**

Reporting to the Manager of the Digital Media Commons, the incumbent will be supporting new and cultural media learning services to a diverse cross-disciplinary environment of students, faculty and the public.

The Digital Media Commons (DMC) consists of space and technologies for students, faculty and the public to explore traditional and emerging digital collections, high-end Apple hardware, edit suites, touch tables, cutting edge gaming PCs, retro and contemporary gaming consoles and software as well as audio and visual carrels. It is intended to be a place to facilitate exploration and creation of new and cultural media forms such as animation, soundscapes and maintaining a progressive position in new and cultural media applications within an academic environment.

Primary Purpose of the Position (*Key purpose, functions, roles*)**:**

The primary purpose of this position is to provide operational support for digital media equipment and software within the Digital Media Commons including Mac Pro computers, Magic Planet digital globe, SMART Touch Tables, PC and Mac A/V Edit suites, DJ Controller/Mixers, Gaming PCs, retro and contemporary gaming consoles, 3-D Printers and scanners, and providing operational support for Audio/Video previewing stations and auditory and visual collections in the

Visual and Performing Arts (VPA) department.

The position plays an important role assisting the manager in ensuring the smooth daily operations of the Digital Media Commons. This requires working closely with students, Faculty, staff and members of the public.

Qualifications/Expertise:

Required
Completion of some courses in Computer Science or a digital media related discipline
Strong background in Mac and PC's
Excellent skills in working with people in a problem-solving and support environment
Excellent written and verbal communications skills
Experience setting up and installing hardware and software,
Relevant working knowledge of digital media creation software
Experience with troubleshooting and support of computer equipment
Experience with gaming hardware (PC, console, handheld)
Experience in SMART technology, including touch tables
Experience with A/V viewing/listening equipment

Accountabilities, Tasks, and Duties (*Results and outcomes expected when roles are carried out successfully, with supporting details on how results are accomplished*)**:**

Maintenance

Technical systems are fully functional and available to users whenever the Digital Media Commons (DMC) is open to the public.
New software is installed as requested and required
Ensure equipment and area is clean and presentable
Diagnose and correct simple hardware problems
Assist users with both hardware and software problems
Train users in the use of various technologies, with the goal being user competence and independence

Client Services

Users are courteously provided with information and advice about programs and services offered by the Digital Media Commons.
Users are provided with necessary technical assistance to operate audio/visual and digital media equipment.
Users are provided with access to reserved equipment, media and facilities in the DMC and Visual and Performing Arts
Users and potential users are aware of programs and services offered via DMC and VPA

Ensure users are following proper policies and procedures when booking and using equipment
Host and/or assist with workshops for students on Digital Media related topics

Communications / Relationships

Tracking usage of DMC technologies and applications
Collecting examples of digital media creations completed using DMC technologies for promotional purposes
Informs Digital Media Commons Manager of emergencies and new developments in a timely manner
Ability to work independently and as part of a team
Ensures that the Manager is kept informed of activities and progress of work; shares information regarding projects and activities with others
Collaborate and communicate directly with Visual and Performing Arts and other LCR service points staff

Occupational Health & Safety

- Understands and complies with the requirements of the University's Occupational Health and Safety Policy.
- Has knowledge of and understands the expectations of the University's Occupational Health and Safety Management System (OHSMS) and applicable Faculty/Departmental/Unit specific health and safety policies and procedures.
- Ensures that all work conducted is in accordance with the Alberta Occupational Health and Safety Act, Regulation and Code and other health and safety legislation as applicable

Core Competencies

The University has established 8 core competencies that flow from its mission and values. Competencies define the behaviours, knowledge and skills important for University of Calgary staff. Further information about the 8 competencies and detailed definitions can be accessed on the Human Resources website at www.ucalgary.ca/hr, or through contacting Human Resources.

Each of the 8 competencies is important for staff at the University. Applying relative weightings to them identifies which of the 8 are especially important for a particular position. Relative weightings assist with selection and performance development processes. Most job profiles have 3 to 4 competencies selected as having CRITICAL IMPORTANCE, with the rest being selected as having CORE IMPORTANCE. Please choose the relative weightings below.

1. **COMMUNICATION** *(Ability to share information in an effective and collaborative manner)*

   Critical Importance\

2. **INNOVATIVENESS/INITIATIVE** (*Ability to be creative, challenge and demonstrate initiative to generate improvements and foster positive outcomes)*

   Core Importance

3. **TEAMWORK** (*Ability to function effectively in team situations both within and across departments and other organizations to achieve optimal collective results)*

   Core Importance

4. **KNOWLEDGE AND TECHNICAL SKILLS** (*Ability to demonstrate proficiency in technical and job knowledge aspects of the position to achieve a high level of performance. An ability and a desire to learn)*
   Critical Importance

5. **PERSONAL EFFECTIVENESS** *(Ability to demonstrate respect, dignity and integrity in interpersonal relationships and to demonstrate positive personal coping and wellness strategies)*

   Core Importance

6. **UNIVERSITY UNDERSTANDING** *(Ability to demonstrate effectiveness within the University environment and demonstrate an understanding of the University context)*

   Core Importance

7. **LEADERSHIP** (*Ability to achieve positive outcomes by encouraging, supporting, coaching, developing and mentoring others)*

   Core Importance

8. **FLEXIBILITY** *(Ability to adapt and respond to the changing environment and to constructively create opportunities for change through active participation)*
.

   Critical Importance

Staff Member:	**Date (yy-mm-dd):**
Team Leader/Supervisor:	**Date (yy-mm-dd):**
Dean/Director (optional):	**Date (yy-mm-dd):**

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EMERGING TECHNOLOGY SERVICES LIBRARIAN
VACANCY ANNOUNCEMENT

The NCSU Libraries has a well-earned reputation for creating adventurous library spaces and innovative services that delight today's students and researchers. Soon we will open a magnificent new library that promises to be nothing less than the best learning and collaborative space in the country. Located on NC State's Centennial Campus, the James B. Hunt Jr. Library will be an iconic space, a place where people gather to explore new ways to research, learn, experiment, collaborate, and affect the world. Designed as a working incubator for educational technology, this is a library that features dynamic video walls, computing and visualization spaces, gaming and media labs, and group collaboration rooms, as well as 2 million print volumes housed in the bookBot, an automated book delivery system. The Hunt Library will serve as a second "main library," complementing the D. H. Hill Library, with services focused on the Centennial Campus community. Centennial Campus, adjacent to NC State's main campus, includes the colleges of Engineering and Textiles, more than 75 science and technology research centers, and 60+ corporate, government, and non-profit partners. If you are a person who would like to provide a new generation of library users with everything they can imagine and more, consider applying for the following position.

The NCSU Libraries invites applications and nominations for the position of **Emerging Technology Services Librarian** to join the Learning Commons team. The NCSU Libraries has a Learning Commons in the D. H. Hill Library and will offer two large Learning Commons in the Hunt Library. These Commons are active, collaborative, comfortable spaces with workstations, productivity software, group work areas, and flexible seating. Learning Commons staff and trained student peer advisors provide research and technology assistance and programming to support users of these spaces.

Responsibilities
The Emerging Technology Services Librarian

- provides frontline services for digital media and technology equipped spaces in the James B. Hunt Jr. Library, including the Technology Showcase, gaming lab, group studies, and media rooms
- manages the technology-lending program at Hunt Library, working closely with students and faculty to identify emerging needs for new devices and software
- recruits, trains, and supervises students who provide peer-to-peer support and instruction for related services
- publicizes the Libraries' digital media resources and technology services and updates and maintains related information on the Libraries' website
- participates in library planning, serves on library-wide committees, task forces, and teams

NCSU librarians are expected to be active professionally and to contribute to developments in the field. Reports to the Director of Learning Commons Services.

Required qualifications:

- ALA-accredited MLS or equivalent advanced degree in library or information science
- experience with digital media including some combination of video and audio production, 3D modeling, data visualization, and/or game design
- demonstrated commitment to creative, high-quality library services and facilities
- outstanding written and oral communications and interpersonal skills
- supervisory ability and the ability to work both independently and in a team environment
- evidence of ability for ongoing professional development and contribution

Preferred qualifications:

- knowledge of applications of current and emerging digital media technologies as they contribute to meeting the needs of students and researchers

•relevant experience, including engagement with a user community

The Libraries, the University, and the Area
The NCSU Libraries and its staff have won numerous awards, including the first Association of College and Research Libraries' **Excellence in Academic Libraries Award**, *Library Journal*'s **Librarian of the Year**, **Paraprofessional of the Year, and** six **Movers and Shakers** awards. The library system currently consists of the D. H. Hill Library and branch libraries for design, natural resources, textiles, and veterinary medicine, with the James B. Hunt Jr. Library opening soon. With a staff of 260+ FTE, the Libraries has more than 4.4 million volumes in its collection, acquires more than 62,000 print and electronic serials, and has a total annual budget of over $25 million, with approximately $9.5 million allocated to collections. The Libraries is the host site for NC LIVE, a multi-type library initiative making digital resources accessible to North Carolina residents.

The NCSU Libraries is a member of the Association of Research Libraries, the Digital Library Federation, the Coalition for Networked Information, the Scholarly Publishing and Academic Resources Coalition, the Council for Library and Information Resources, and the Center for Research Libraries. Duke University, the University of North Carolina at Chapel Hill, North Carolina Central University, and North Carolina State University form the Triangle Research Libraries Network (TRLN), with combined resources exceeding 14 million volumes and collections budgets totaling more than $30 million.

Recognized as one of the nation's leading universities in science and technology, with strong programs in the humanities and social sciences, NC State offers degrees through the Colleges of Agriculture and Life Sciences, Design, Education, Engineering, Humanities and Social Sciences, Management, Natural Resources, Physical and Mathematical Sciences, Textiles, and Veterinary Medicine. As the largest academic institution in the state, NC State enrolls more than 34,000 students and offers doctoral degrees in 61 fields of study. The university is ranked third among all public universities (without medical schools) in industry-sponsored research expenditures and has more than 660 active patents. NC State is a national leader in networking technologies and a charter member of the North Carolina Networking Initiative (NCNI), an Internet2 initiative with the most advanced operational networking system infrastructure in the nation.

Between the mountains of the Blue Ridge and the shores of the Outer Banks lies North Carolina's Research Triangle of Raleigh, Durham, and Chapel Hill. One of the nation's premier concentrations of academic, corporate, and public research, the area combines moderate year-round temperatures, rolling hills, championship college athletics, and a rich diversity of cultural events. The Triangle consistently ranks high on lists of desirable American communities, including recent ratings by ***Forbes*** as the number-one place for business and careers and as the number-two spot for young professionals.

Salary and Benefits
The Libraries offers a highly competitive salary in recognition of applicable education and experience for this position. Librarians have non-tenure track faculty status (without levels of rank). Benefits include: 24 days vacation, 12 days sick leave; State of NC preferred provider medical insurance, and state, TIAA/CREF, or other retirement options. Additional and optional dental, life, disability, deferred compensation, and legal plans are offered. Tuition waiver program for all campuses of The University of North Carolina is available. More benefits information is available at http://www7.acs.ncsu.edu/hr/benefits/

Application process and schedule
Applications will be reviewed upon receipt; applications will be accepted until finalist candidates are selected. Candidates are encouraged to apply as soon as possible to receive full consideration. The nomination committee may invite candidates for confidential, pre-interview screenings. Appointment requires successful completion of background check. This position is available immediately; start date is negotiable.

Applicants must apply through the NC State University online employment website at http://jobs.ncsu.edu/postings/677 . Complete application, and attach cover letter and résumé, with contact information for four current, professional references. For assistance with this process contact NCSU Libraries Personnel Services Office (919) 515-3522.

Affirmative Action/Equal Opportunity Employer
NC State welcomes all persons without regard to sexual orientation
Persons with disabilities requiring accommodations in the application and interview process please call (919) 515-3148.

10/11

POSITION DESCRIPTION

SIU CARBONDALE
LIBRARY AFFAIRS

Title of Position: Lecturer (Science Librarian)

Appointment: Lecturer, full-time, 12 month, term, renewable, Non-Tenure-Track

Responsibilities: Under the general direction of the Associate Dean for Information Services and responsive to input from the Dean of Library Affairs , the Science Librarian provides reference, instruction, liaison, collection development, outreach, and general library services to the University community. Specific responsibilities include:

- Assists patrons at the Information Desk with research and reference questions, including limited nights and weekends. Provides general reference service via face-to-face, online, email, chat, phone, and consultation means.
- Instructs students and faculty in the use of library resources and technologies, as well as in information access, evaluation, and management in face-to-face and online settings as appropriate. Assists in the development of instructional curricula (including for credit and non-credit courses), online learning modules, web pages, user guides, and assessments.
- Serves as subject specialist and liaison to departments covering Science disciplines, providing formal and informal instruction in library research for these departments. Assists with subject-specific research queries in areas of expertise. Identifies opportunities for outreach and strategic partnerships with specific SIU departments based on expertise.
- Assists with student recruitment, orientation, and retention strategies.
- Selects monographs and recommends other resources for science disciplines. Participates in other collection development activities as needed.
- Participates in the library's scholarly communication initiatives, including the population of the Institutional Repository.
- Serves on library and university committees.
- Other duties and responsibilities as assigned.

Required Qualifications:

- ALA-accredited master's degree in Library Science (MLS) awarded by date of appointment.
- Bachelor's degree in a science or engineering discipline.
- Proficiency in the use of general and subject-specific reference resources and in conducting library research.
- Experience creating web-based guides and tutorials (e.g., LibGuides).
- Working knowledge of a wide variety of information technology applications (e.g., Microsoft Office) and databases.
- Excellent interpersonal and oral and written communication skills.
- Demonstrated strong organizational skills, including the ability to manage projects, and multiple tasks while meeting deadlines and solving problems in a complex and dynamic environment.
- A strong customer-service orientation.
- Demonstrated ability to work independently and collaboratively with diverse faculty, staff, and students in a rapidly-evolving, team-oriented environment.

Preferred Qualifications:

- Additional master's degree in a science or engineering discipline.
- Speaking, reading and writing knowledge of a second language.
- Experience working in an academic library.
- Teaching experience.
- Collection development experience.
- Familiarity with online learning management systems and tools.
- History of working with diverse populations and college students.
- Experience writing, obtaining, and managing grants.

_____ _____
Incumbent Date

_____ _____
Associate Dean for Information Services Date

_____ _____
Dean of Library Affairs Date

UNIVERSITY OF VIRGINIA
Scholars' Lab | Expanding Our Makerspace Community
http://scholarslab.org/uncategorized/expanding-our-makerspace-community/

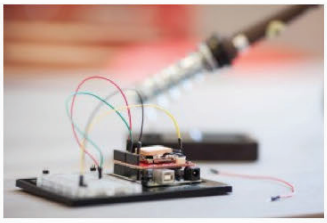
SCHOLARS' LAB

about research fellowships makerspace events blog people

Expanding Our Makerspace Community

By Laura Miller · May 5, 2015

Are you a UVA graduate student or upper-level undergraduate in the humanities? Interested working in our Makerspace?



Our Makerspace is designed to foster experimentation with 3D modeling and printing, physical computing (e.g. Arduino, wearables) and more. We are seeking part-time student consultants to help maintain the public space, field users' basic maker and general computing questions, and connect researchers to Scholars' Lab staff when necessary. When not actively engaged with users, students will be asked to experiment with the equipment, to pursue their own research, and to publish their processes and observations on the Scholars' Lab blog. They will also be expected to conduct informal workshops to train new users.

Experience with 3D modeling and printing, electronics, sewing, and/or programming preferred, but can be learned on the job. The successful candidate will be able to work up to 10 hours per week.

An important aspect of the maker culture is apprenticeship and supporting makers in their pursuit of professional experience. We are looking for motivated individuals who are capable of working independently and value the opportunity to engage with and support a growing community. Benefits of the job may include: access to expertise and mentoring in your field of interest, use of equipment and tools, and ability to shape Scholars' Lab workshops and programming.

Candidates should include a cover letter discussing their interest in working in the Scholars' Lab, detailing any experience or interest in participating in a maker space, and outlining any previous experience with public service or assisting others in using technology.

If you would like to apply, please fill out an application in CavLink.

SELECTED RESOURCES

Books and Journal Articles

Colegrove, Patrick. "Making It Real: 3D Printing as a Library Service." *Educause Review Online*. October 27, 2014. http://er.educause.edu/articles/2014/10/making-it-real-3d-printing-as-a-library-service

Gershenfeld, Neil. *Fab: The Coming Revolution on Your Desktop—From Personal Computers to Personal Fabrication*. New York: Basic Books, 2005.

———. "How to Make Almost Anything." *Foreign Affairs* 91, no. 6 (November/December 2012): 43–57. https://www.foreignaffairs.com/articles/2012-09-27/how-make-almost-anything

Horvath, Joan. *Mastering 3D Printing*. New York: Apress, 2014.

Johnson, Larry, et al. *NMC Horizon Report > 2015 Higher Education Edition*. Austin, TX: The New Media Consortium, 2015. http://www.nmc.org/publication/nmc-horizon-report-2015-higher-education-edition/

Lipson, Hod, and Melba Kurman. *Fabricated: The New World of 3D Printing*. Indianapolis, IN: John Wiley & Sons, 2013.

Michele Moorefield-Lang, Heather. "Makers in the Library: Case Studies of 3D Printers and Maker Spaces in Library Settings." *Library Hi Tech* 32, no. 4 (2014): 583–93.

Scalfani, Vincent F., and Josh Sahib. "A Model for Managing 3D Printing Services in Academic Libraries." *Issues in Science and Technology Librarianship* 72 (Spring 2013). http://www.istl.org/13-spring/refereed1.html

Vaughan, William. *Digital Modeling*. Berkeley, CA: New Riders, 2012.

Wapner, Charlie. "Progress in the Making: 3D Printing Policy Considerations through the Library Lens." *OITP Perspectives* 3 (January 2015). http://www.ala.org/offices/sites/ala.org.offices/files/content/3D%20Library%20Policy-ALA%20OITP%20Perspectives-2015Jan06.pdf

Websites

Make: magazine
http://makezine.com/

MIT Program on Information Science
Makers in Libraries
http://projects.informatics.mit.edu/maker

Conferences and Events

MakerCon
http://makercon.com/

Maker Faire
http://makerfaire.com/

Model Collections

3D Content Central
http://www.3dcontentcentral.com/default.aspx

3DFileMarket.com
http://3dfilemarket.com/

3D Warehouse
https://3dwarehouse.sketchup.com/

CGTrader
http://www.cgtrader.com/3d-print-models

GrabCAD
https://grabcad.com/library/category/3d-printing

MakerBot Thingiverse
http://www.thingiverse.com/

NIH 3D Print Exchange
http://3dprint.nih.gov/about

YouMagine
https://www.youmagine.com/

Note: All URLs accessed August 26, 2015.