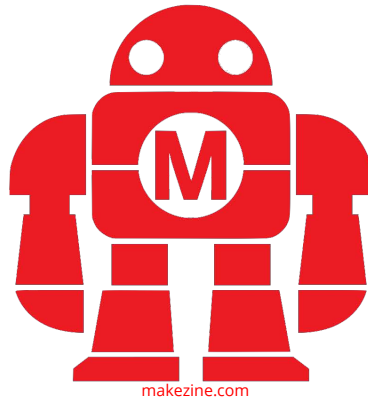


# Making It At Lafayette

*Engaging Members of the Lafayette Community with the  
Maker Movement*



Lafayette College Technology Clinic Fall 2015 Mid-Year Report  
Sponsored by the Skillman Library

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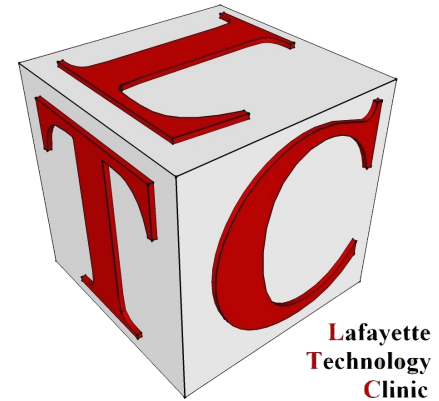
# Our Objective

Skillman Library contacted Technology Clinic to find a way to engage members of the campus with the Maker Movement.

The main goal of our project is to envision ways in which the Maker Movement can be integrated into the Lafayette learning experience.

# What is Technology Clinic?

Founded in 1986, the Technology Clinic is a program that gathers an interdisciplinary group of students who work with real-world clients to develop technology-based solutions to unique challenges. Each team consists of students who are nominated by professors from departments in the natural sciences, social sciences, engineering and humanities. Drawing from such a vast array of unique disciplines, each Technology Clinic team utilizes its multifaceted skill set to approach tasks in a collaborative, dynamic manner. Since its establishment, the Technology Clinic has completed over 75 projects for various clients in the Lehigh Valley area.



# Technology Clinic 2016: The Team



# Technology Clinic 2016: The Team



**Aleeza Ajmal ('18)** is a sophomore from Islamabad, Pakistan. She is pursuing a major in Chemical Engineering along with a minor in Economics. On campus, Aleeza is the President of Minority Scientists and Engineers, a peer tutor for Math 161 and Math 162, an assistant student worker in the office of Engineering, and a gallery monitor in the Williams Arts Center. After graduation, Aleeza plans to attend graduate school to pursue a Master's degree in Petrochemical Engineering with a concentration in Nanotechnology.



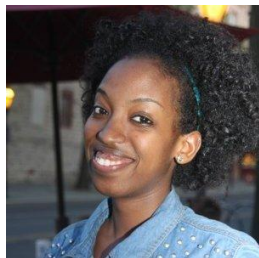
**Nick Gates ('17)** is a junior from Andover, MA. He is a double major in Economics and Environmental Studies, pursuing a Certificate of Financial Policy and Analysis. On campus, Nick writes for the student newspaper, competes on the ski team, and serves as a representative for Delta Kappa Epsilon on the Inter Fraternity Council. Upon graduating, Nick is considering a career in the financial industry, where he hopes to explore the developing idea of sustainable investing.



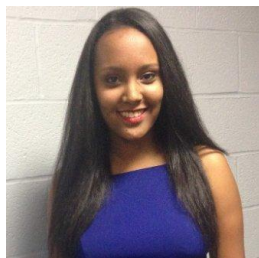
**Emily Lubas ('16)** is a senior from Linden, NJ. She is a B.S. Biology major. Emily is a Team Leader and Program Coordinator with the Landis Community Outreach Center and plans events on campus aimed to raise awareness and support for hunger and homelessness in America. She served as Assistant Executive Director of the Pre-Orientation Service Program and is a facilitator in Alpha Gamma Delta. Emily plans to attend medical school following her undergraduate career in hopes of becoming a physician.



**Rachel Rubino ('17)** is a junior from Newtown Square, PA. She is a double major in French and English with a concentration in Writing. On campus, Rachel serves as a Writing Associate and the Editor of the Marquis Literary Magazine. In addition, she serves as the Environmental Education Intern for the Lehigh Valley Alliance for Sustainable Communities. Rachel is considering a job in the field of teaching upon graduation.



**Flavia Umulisa ('17)** is a junior from Kigali, Rwanda. She is pursuing a major in International Affairs with an Economics minor. On campus, Flavia serves on the board of the Lafayette African and Caribbean Student Association and is part of the Lafayette Initiative for Malagasy Education program. Upon graduating, she hopes to attend graduate school to receive a Master's Degree in International Affairs with a focus in Human Rights education.



**Katim Woldemariam ('17)** is a junior from Addis Ababa, Ethiopia. She is a double major in Government & Law and Economics, with a concentration in Financial Policy and Analysis. On campus, Katim serves as a Resident Advisor and a board member of the International Students Association. After Lafayette College, she plans to earn an Advanced Degree in Development Economics.

# Faculty Facilitators

- **Dr. Dan Bauer** is a Professor Emeritus of Anthropology at Lafayette College, as well as the Director Emeritus and Founder of Technology Clinic. His interests range from engineering and technology to journalism and photography. Throughout his career as an anthropologist, he has completed researched in how communities within Ethiopia and Mexico can utilize local technology to solve problems.
- **Dr. Luis Schettino** is Assistant Professor of Psychology and Neuroscience at Lafayette College. His interests include the neural bases of motor control, motor cognition and the interface between the Arts, Creativity and Cognition. His research uses a number of custom-built hardware and software to test human behavior.

**Contact Information:**  
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schettil@lafayette.edu



lafayette.edu



lafayette.edu



# Our Client: The Skillman Library



[library.lafayette.edu](http://library.lafayette.edu)

**The Lafayette College Skillman Library** is a hub of research and informational sources for faculty and students, as well as for the general public of Easton, Pennsylvania.

As an academic institution, Lafayette College is unique in the sense that it offers both Liberal Arts and Engineering curriculums. The Skillman Library serves as an open forum where various disciplines can interact.

Working for the Skillman Library, the Technology Clinic will focus on how the Maker Movement can be integrated into the Lafayette Community.

# Our Client Liaisons:

Neil McElroy - *Dean of Libraries*

Terese Heidenwolf - *Director of Research and Instructional Services*

Kylie Bailin - *Director of Outreach and Access Services*

Jonathan Macasevich - *Library Technology Specialist*



THE  
MAKER  
MOVEMENT

enterrasolutions.com

“The **Maker Movement**, as we know, is the umbrella term for **independent inventors, designers and tinkerers**. A convergence of computer hackers and traditional artisans, the niche is established enough to have its own magazine, **Make**, as well as hands-on Maker Faires that are catnip for DIYers who used to toil in solitude. Makers tap into an American admiration for **self-reliance** and combine that with **open-source learning, contemporary design** and **powerful personal technology** like 3D printers.”

- Adweek.com

# The Maker Movement

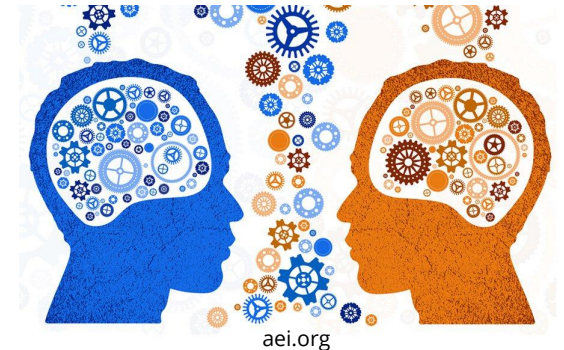
- The Maker Movement comprises the forefront of technological innovation. Combining technology with the act of “Making,” the Movement encourages individuals to turn imaginative ideas into a tangible reality.
- The goal of the Maker Movement is to introduce cutting edge technology to the technologically challenged. Backed by a substantial “Maker community,” the movement focuses people power and computer power to develop countless physical products.
- Several online databases exist to as a result of the Maker Movement. One example is the MakerBot Thingiverse, where individuals can create, share and download 3D printable objects. It is a user friendly site that encourages both beginner Makers and advanced Makers to share their products and participate in the Maker Movement.



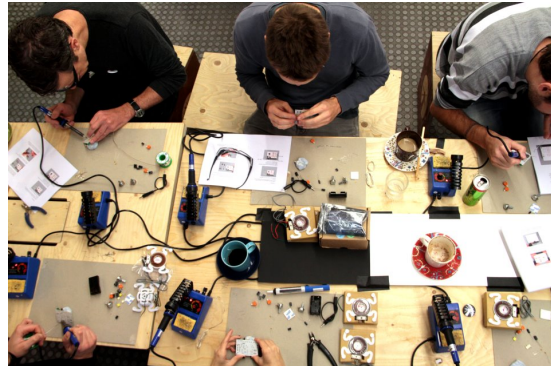
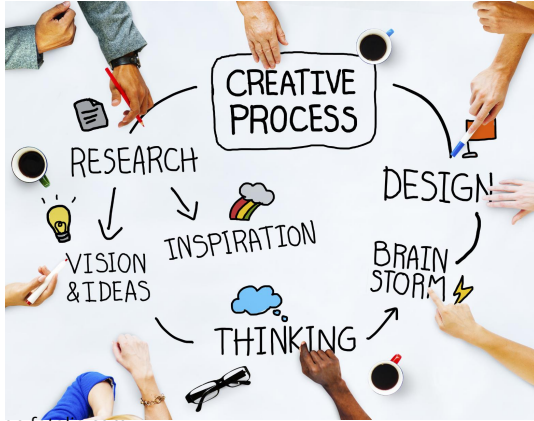
# The Power of Making

There are many academic advantages to the Maker Movement. These benefits include:

- **HANDS-ON LEARNING-** Makers build physical objects; they learn through active participation. In tackling challenges with a “DIY” attitude, Makers learn to differentiate between the theory of a problem, and the practice which is best applied to solve it.
- **INTELLECTUAL EXPLORATION-** The Maker Movement encourages individuals to break out of their learning comfort zones, and discover new territories in academia.
- **INTERDISCIPLINARY COLLABORATION-** The problem-solving, prototyping, designing, and tinkering that occur in line with the Maker Movement can be applied across all fields of study. Each Maker has his or her own individual background of knowledge and expertise, and shares the common goal of making things. Makers frequently join forces to address and solve the various complexities of problems and challenges.



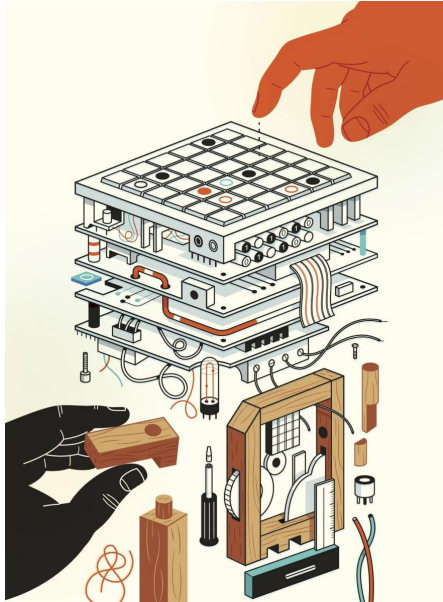
# The Power of Making



iq.intel.com

- **ADVOCACY OF THE INDIVIDUAL LEARNER-** Self-directed, “DIY” learning nurtures a student’s sense of independence. When a person identifies him or herself as a Maker, it means they have determined a confidence in his or her own abilities to confront problems and solve challenges.
- **PERSONAL GROWTH-** The Maker Movement has the power to transform individuals from consumers to creators. Makers can introduce their inventions to a commercial market, and ultimately reap success if the product appeals to broader audiences. This, in turn, empowers the individual Maker and aids the community at large.
- **PROMOTION OF STUDENT CREATIVITY-** Inventive endeavors are twofold. Apart from imagining an idea, Makers are challenged to utilize their creativity to confront limitations their original design may have.

# The Power of Making



newyorker.com



- **FOSTERING OF TECHNOLOGICAL LITERACY-** The Maker Movement promotes computational education in techniques, skills, and processes used to accomplish objectives that demand a creative outlook.
- **ACCESSIBILITY OF LEARNING OPPORTUNITIES-** The Maker Movement facilitates informal learning opportunities where a student freely explores ideas beyond the wall of a classroom. Makers access the expertise of a mentor who freely shares and promotes his or her designs. Makers with higher credentials are there to share their information and work with Makers who may not be experienced in a particular field, yet hold interest in it. This open sense of community greatly helps Makers develop their skills, and sustain the platform of collaboration and accessibility that is essential to the Movement at large.

A word cloud of terms related to the Maker Movement. The words are arranged in a roughly rectangular shape, with the largest word, 'shared', in the center. Other prominent words include 'community', 'technology', 'collaboration', 'engagement', 'interdisciplinary', 'accessibility', 'aesthetics', 'peer-to-peer', 'open', 'DIY', 'challenge', 'forward-thinking', 'spaces', 'printing', 'prototyping', 'interactive', and 'hands-on'. The words are in various colors (red, orange, yellow, green, purple) and orientations (horizontal and vertical).

cooking  
collaboration  
engagement  
interdisciplinary  
technology  
expertise  
source  
smart  
aesthetics  
peer-to-peer  
open  
DIY  
challenge  
forward-thinking  
spaces  
printing  
prototyping  
interactive  
hands-on  
MOVEMENT

shared

community

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invention

inclusive

makers

majors

accessibility

arduino

technology

expertise

source

smart

aesthetics

peer-to-peer

open

DIY

challenge

forward-thinking

spaces

printing

prototyping

interactive

hands-on

MOVEMENT



# Engaging Lafayette's Mission

*"Students and faculty from the arts, the sciences, and engineering are setting new standards for interdisciplinary collaboration and creating novel practices that spark discovery." - Lafayette Website*

## OUR GOALS:

- To reinforce the interdisciplinary connection between academic departments at Lafayette
- To introduce Lafayette students and faculty to the benefits of making things
- To develop Maker "Invitations" for community members to introduce them to the Maker Movement and give them the opportunity to practice their Maker skills
- Establish a community of Makers at Lafayette to strengthen the Movement as a whole



unigo.com

# Making Knowledge

*Our mission is to introduce the Maker Movement to the Lafayette community and encourage students from all departments and backgrounds to think innovatively, and to apply their knowledge beyond the classroom. The Maker Movement allows students and faculty alike to learn through “Making” in a hands-on fashion; each tool used provides a unique way of thinking and of confronting real-world problems or inspirations. Integrating this process into academic discussions and endeavors will implement a fresh, progressive understanding of the connection between the college’s fields of Liberal Arts and Engineering.*



# What is a Makerspace?



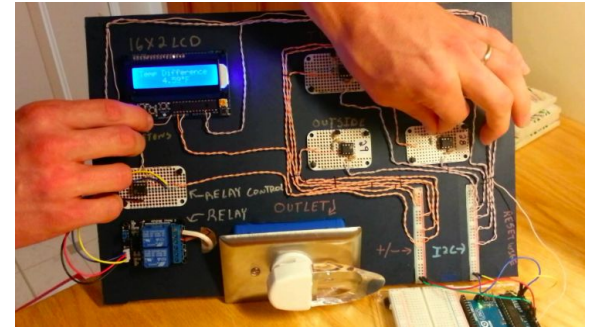
- A room or variety of rooms equipped with tools and materials for Making
- A space to tackle hands-on activities that encourage creativity, design, and innovation
- A bright, open area to engage student and faculty collaboration
- A place to communicate with other Makers or work alone to develop ideas and methods
- A specialized atmosphere that allows one to tinker with his or her own unique creations

# How Making is Done

Many different kinds of tasks can be accomplished in a Makerspace, depending on the type of object the Maker is seeking to create.

Numerous Maker projects utilize design software, computer programming, and electronic prototyping platforms. The technological, computational labor these kinds of projects require, at first, often progress into a more physical domain. For instance, a code designed on 3D Printing Software can be transferred to a 3D Printer to make small plastic parts. These parts can be utilized to assemble an object such as a robot or a prosthetic limb. An Arduino Board can then be programmed to animate these creations.

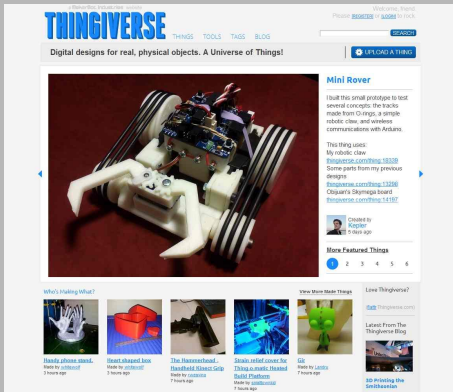
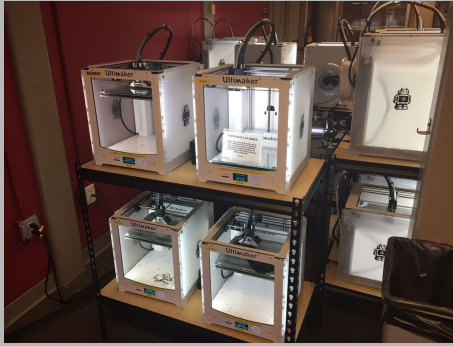
A range of other projects involve direct, physical application from the get-go. The repurposing or purposing of these kinds of objects will usually take place shortly after the initial product planning. These sorts of projects vary from woodworking and engraving to pottery making and sewing, to name a few.



**From Handcrafted Circuit Boards  
to Handcrafted Fabrics**



# MakerSpace Projects



- **Open Source Sharing**  
(Maker.com, Thingiverse.com, etc.)
  - Share and discover codes and project ideas with other Makers
- **3D Design**  
(Tinkercad, Sketchup, AutoCAD, etc.)
  - Design drawings for 3D-printed objects
- **3D Printing**  
(Makerbot, Ultimaker, Zortrax, Dual Extrusion, Printrbot etc.)
  - Print objects like tools, toys, moveable parts, topographical maps, prosthetic limbs, and much more
  - Objects can be printed in mediums such as ABS plastic, metal, wax, etc.
- **Electronic Prototyping Platforms**  
(Arduino, Raspberry Pi, etc.)
  - Program computational electronics
- **Robotics**  
(Instructables, ELab Peers, etc.)

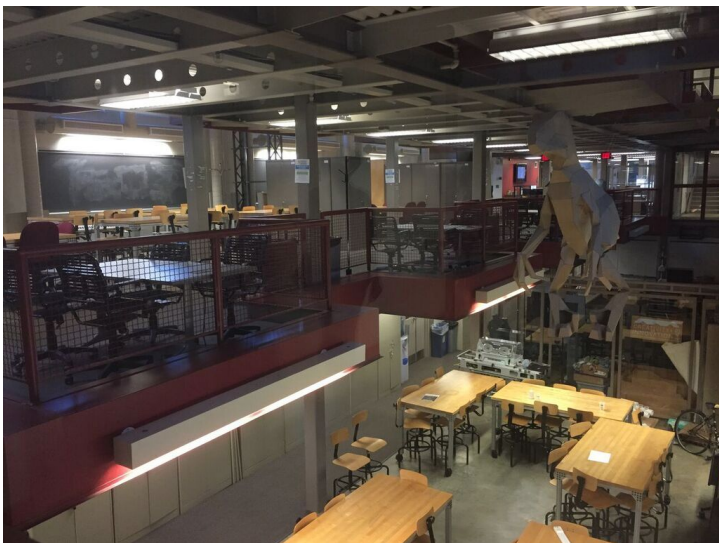
# Makerspace Projects

- **Repurposing**
  - Using recyclable objects to build new things
- **Sewing**
  - Crocheting, knitting, quilting, etc.
- **Woodworking**
  - Crafting instruments, furniture, etc.
- **Cooking**
  - Creating recipes, chef challenges, etc.
- **Graphic Art & Design**  
(Adobe Photoshop, Serif DrawPlus, etc.)
  - Designing and creating advertisements, books, etc.
- **Physical Art**
  - Pottery, painting, drawing, engraving, etc.
- **Musical Composition**  
PreSonus Studio, Peavey Mixer, etc.
  - Playing instruments, Recording songs on a soundboard, editing songs on music software, etc.
- And much more



# CASE STUDIES: SUCCESSFUL MAKERSPACES IN THE LEHIGH VALLEY

**Lehigh University:**  
*The Wilbur Powerhouse*



**Northampton Community College:**  
*The Fab Lab*



# Lehigh University Makerspace

The Wilbur Powerhouse was established in 2002 and is open to all of Lehigh's graduate and undergraduate students. The spacious area is composed of numerous meeting spots, computer labs, and classrooms. It also includes an additive manufacturing Lab for 3D printing as well as a metal and woodworking shop.

The accessibility of the Makerspace and its resources allows both curious students and experienced Makers to explore ideas in an academic, communal setting. This opportunity encourages imaginative thinking and interdisciplinary collaboration.



wfcourier.com





# Lehigh University Makerspace

## ADVANTAGES:

- The Makerspace is contained within an individual building, which allows for ample room to execute activities.
- The space is run by full-time faculty so its hours of operation are extensive. This permits easy access for faculty, students, and anyone on campus.
- Professors can use the space when teaching aspects of their courses. This insures the Makerspace's continued relevance on campus.
- The space promotes curriculum integration.
- Lehigh facilitated one competitive challenge (Hackathon), which ran between the University and other nearby colleges.



## LIMITATIONS:

- There are no enclosed or discrete spaces to serve Makers in the more reflective stages of brainstorming. This lack of privacy may dissuade reserved students from viewing the place as an area to become absorbed by the thoughts of Making.
- The lab had difficulties balancing its technical aspects with a playful vibe
- The University has no motivation to make the space interdisciplinary due to the fact that it already receives high traffic on its own.

# Northampton Community College Makerspace



The Fabrication Laboratory, or “Fab Lab” was established in 2009. The Makerspace is open to the students and faculty of Northampton Community College as well as the Lehigh Valley community at large.

The Lab offers access to a plethora of technologies.

Some of the tools highlighted within the multi-room space include 3d printers, laser cutters, and a spray booth. The space is divided into unique compartments which feature a guitar-making and repair studio, a full metal and woodshop, a computer lab, and a Sound Lab.

The Fab Lab’s mission is to “learn something, make something, [and] be inspired.”



northampton.edu

# Northampton Community College Makerspace

## ADVANTAGES:

- While the Lab promotes the practice of advanced technology, it also takes active steps not to neglect the enforcement of basic skill education. This mindset welcomes new learners into the space, and eases any intimidation they might have when confronting new areas.
- The Lab strikes an even balance between its focus on technological projects (eg: 3D printing) and projects that involve a more physical application (eg: wood working).
- The Lab provides tools for particular hobbies, like wooden guitar making. This attracts Makers with a passion for their hobby. It also contributes a lively dynamic to the space.
- The Lab has full-time staff who are deeply committed to aiding the needs of Makers and overseeing the success of the overall Space.



## LIMITATIONS:

- The Makerspace is contained to one portion of a floor in the college's community center. While the Lab offers a plethora of nooks to complete private work, capacious spaces to tackle larger projects were more difficult to come by.
- Due to its more secluded location, the Lab faces some difficulties establishing its presence and therefore drawing the community in.

# Additional Study: Ed Kerns' Studio

Ed Kerns is a Professor of Art at Lafayette College. He specializes in painting, drawing and two dimensional design. Kerns' philosophy emphasizes the interdisciplinary connection between Making and art. His work seeks to embody the "DIY" mentality.



For instance, Kerns created a unique decorative piece by dipping a floor polisher in paint. He then applied the machine to a large wooden board, which revealed a thought-provoking design.

Besides creating a thought-provoking design, his project provides new knowledge about how materials behave when applied in an unconventional manner.

Our meeting with Kerns provided the team with additional inspiration for the Maker Movement, and its potential for an established presence on campus.

# The Maker Showcase

- In November, the Tech Clinic team hosted a Maker Showcase in Skillman Library.

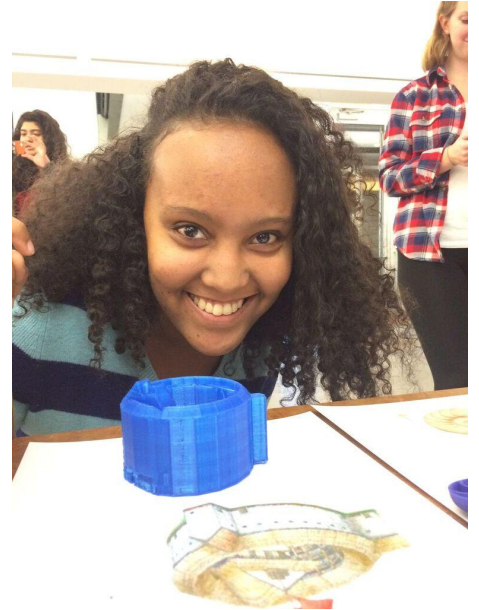
The Showcase was comprised of a variety of displays.

- The exhibition contained numerous 3D printed objects that represented unique fields of academia, as well as Arduino-controlled robots crafted by Tech Clinic members.
- The purpose of the showcase was to demonstrate the Maker Movement to the Lafayette Community, and extend an informal invitation for students and faculty to learn more about the Movement.

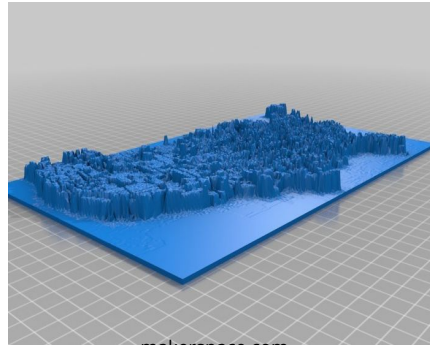
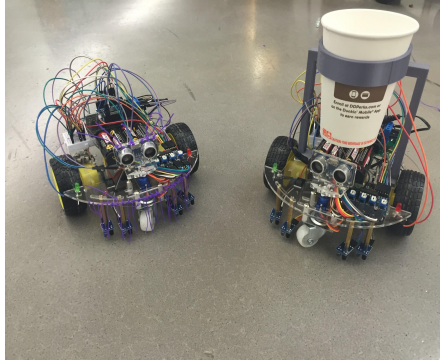
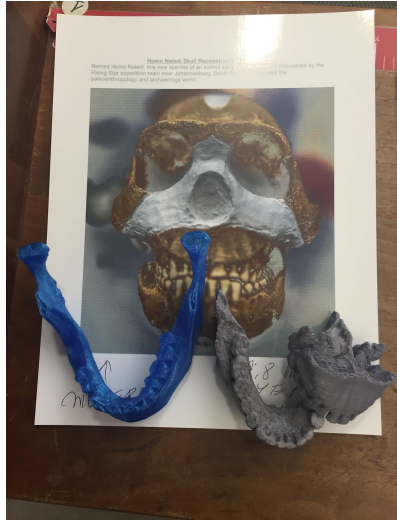


# The Maker Showcase

- The Tech Clinic team aimed to demonstrate the interdisciplinary appeal of the Maker Movement to the Lafayette community. The team did this by displaying 3D printed projects which, contextually, played into a diverse range of academic fields.
  - ie: the team demonstrated how the technological tool of 3D printing can be applied to Liberal Arts studies such as Economics, History, Art, etc.
- The Arduino-Controlled robots scooted around the first floor lobby of the library, and served as a fun way to attract community members' attention.
  - A majority of the Tech Clinic members do not study engineering, but were capable of creating these robots and ultimately enjoyed the challenge.
- The robots, in this sense, demonstrated the accessibility of Maker Movement to students, and how anyone can be a Maker.



# Maker Showcase Items



makerspace.com

## Arduino Powered Robot:

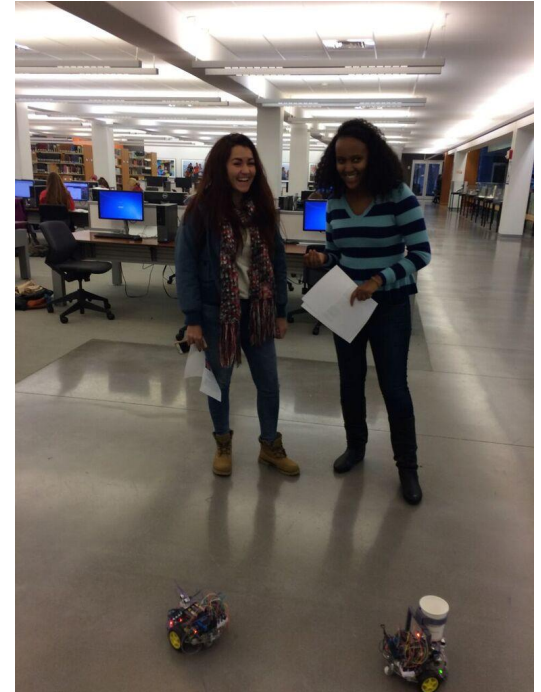
- Formed with software by eLab Peers
- Arduino powered controller board
- 3D Printed decorative parts
- Involved various technical skills like soldering

## 3D Printed items:

- 3D map of unemployment per state in the United States (Economics)
- Anatomically correct prints of prehistoric human jaw (Anthropology)
  - compared with modern day print of jaw
- Scaled version of the Globe Theatre (Engineering, English, Theatre)
- A model of a fractal (Mathematics, Biology)
- Loop (Mathematics)
- Nautilus Shell (Mathematics, Science)
  - portrays the Golden Ratio
- and more!

# The Maker Showcase Results

- We had mixed results from the Maker Showcase.
- Some students expressed interest in the idea, stopping by with various questions and comments.
  - Many of these students were drawn to the robots which were moving around on the floor. This response was positive as it helped us spread word about the movement and our project.
- Most students, however, passed by the display en route to their next task.
- This was partially due to the timing of the event. In the late afternoon, most students visit the library for targeted academic reasons, and are unwilling to make time for other endeavors.
  - Because of this, we reasoned that the event might have been more successful in a less formal setting, such as the Farinon atrium.





# Maker Invitations: Spring 2016

## GOALS:

- Create excitement for making things
- Introduce students to the Maker Movement while motivating and inspiring them to join it
- Demonstrate how anyone can be a Maker
- Challenge students to progress ideas outside of the typical classroom environment
- Implement a stronger connection between the fields of Liberal Arts by reaching out to particular clubs or classes which include an interdisciplinary array of students

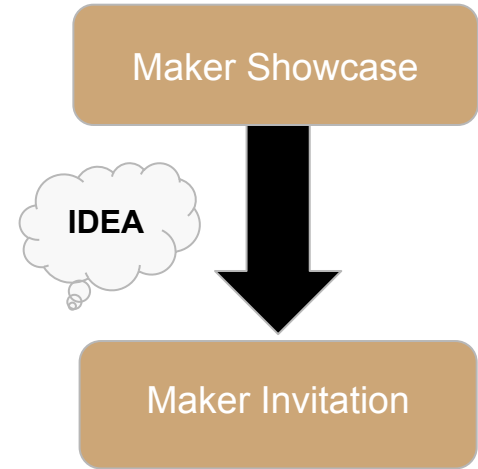


businesskorea.co.kr

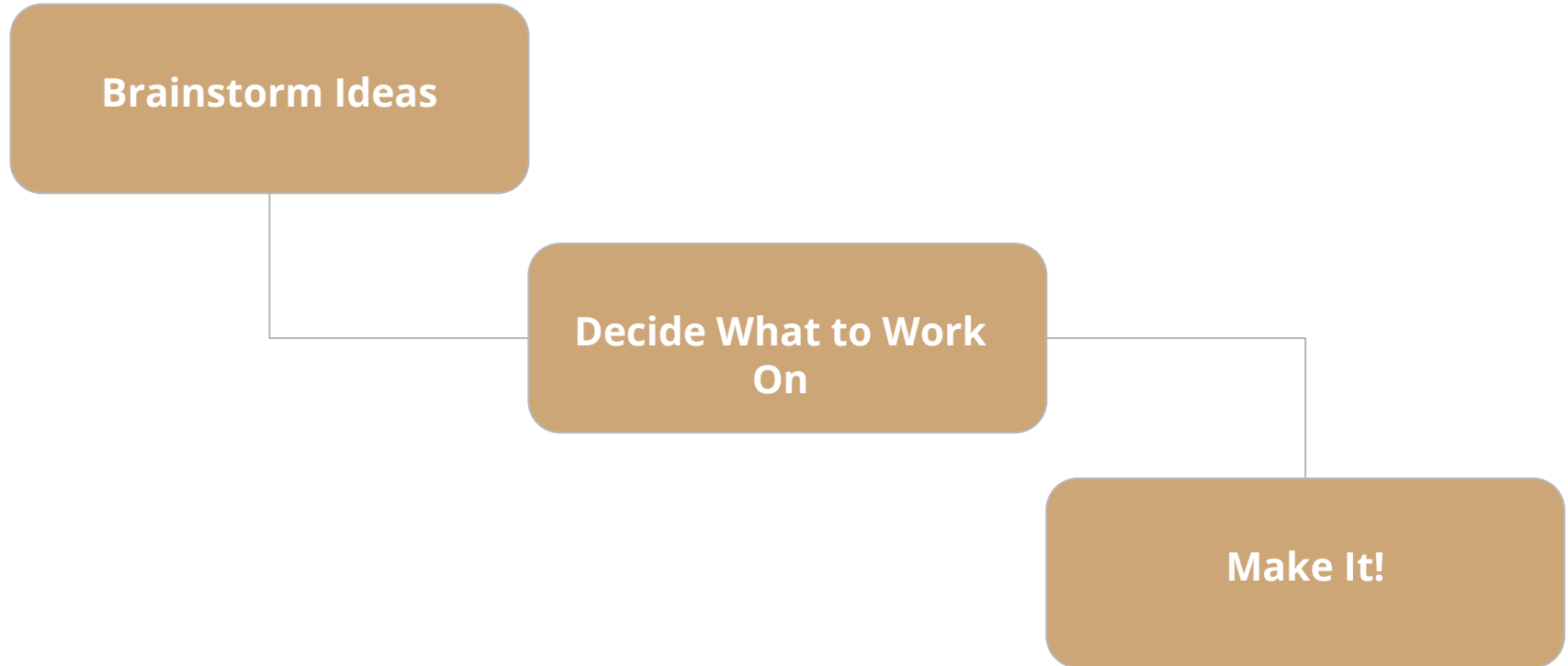


# Developing a Showcase into an *Invitation*

- What We Learned from the Showcase
  - Printing and designing products is a lengthy process
  - Future invitations should be held over a longer time frame
- How We Can Apply These Discoveries to Future Invitations
  - Three-Day *Invitation*
    - Composed of different stages for the Maker to complete
    - Stages involve:
      - 1. Brainstorming ideas
      - 2. Deciding on an idea
      - 3. Making the product



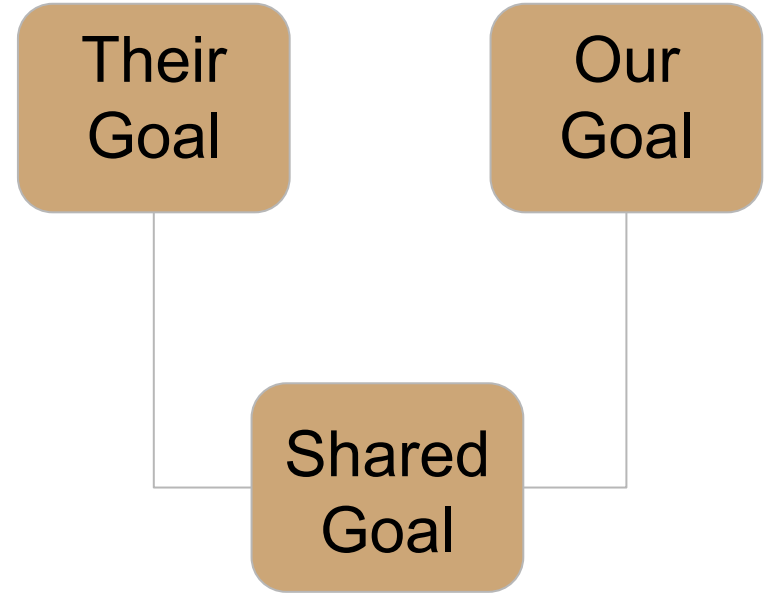
# The Maker's Guide to Approaching an Invitation



# Encouraging Community Engagement

The Tech Clinic team is gearing its strategies toward discovering ways in which we identify an existing group's goals and establish a commonality with our goal.

- This involves asking:
  - 1. What are each of our individual goals?
  - 2. How can these goals match up?
- And finally implementing actions in which we:
  - 3. Discover a common area of interest



# Maker Invitations: Interdisciplinary Maker Workshops

One aspect of the Invitations will include the hosting of various Maker workshops. The Tech Clinic believes that the workshops will help to broaden students' perspectives by exposing them to Maker tools.

From this exposure, students can glean how these tools are applied in a wide variety of subject areas. Maker workshops will also provide them with techniques to apply Maker tools within their own specific Invitational project.

The workshop is ideal for beginner Makers, or those with less experience to realize that one does not need to be an engineer in order to make and design objects.



northampton.edu

# Ideas to Draw Student and Faculty Engagement

- We hope to attract student and faculty participation and interest in the Maker Movement by:
  - Finding ways to connect with faculty members, especially those who have expressed interest in the Maker Movement.
  - Showing professors of all disciplines that Maker technology such as 3D printing can be relevant to their specific subject area
    - For example, Dave Sunderlin expressed interest in working with us next semester for his Geology 320 class. The class will create models that are tied to morphological space.
  - Encouraging faculty across all disciplines to incorporate the Movement into their curriculum by offering extra credit to those who participate and show interest.
  - Enhancing Community Engagement by asking:
    - What is the organization trying to achieve? Can we help them do it better? Do we have overlapping goals that we can work towards?
- By enabling the campus to become more aware about the Maker Movement and its goals, students and faculty alike can get involved.



peterborner.com

# Maker Invitations: Lafayette Clubs & Organizations Outreach

It is integral to Tech Clinic's mission to bring clubs and organizations that are represented on campus to the Movement. We will reach out to organizations that possess goals which match up to our own goals. Such organizations can participate in Invitations under our guidance.

The Invitation will motivate students from these organization to try something new and think outside of the box. Some ideas, in brief, include:

- ❑ LaFarm: use 3-D printed as well as arduino powered tools to collect water for seed beds
- ❑ Lit Mag :create 3-D printed engraved poetry
- ❑ LEAP: modify and repurpose discarded items



# Engaging Campus Groups with the Maker Movement

- Examples of identifying ways in which Maker Techniques can help existing groups accomplish their missions:
  - 1) LEAP's environmental mission might be accentuated by a joint competition aimed at turning discarded objects into useful devices
  - 2) LaFarm emphasizes the environmental and justice values of the locavore movement through direct action. Trips to check on the needs of plants are done at a cost of driving and fuel emissions, which might be reduced using arduino sensors and wifi.
    - refer to- Internet of Farming: Arduino-based, backyard aquaponics  
[www.youtube.com/watch?v=X2wWTadsBDA](http://www.youtube.com/watch?v=X2wWTadsBDA)



[www.youtube.com/watch?v=UoBUXOOdLXY](http://www.youtube.com/watch?v=UoBUXOOdLXY)

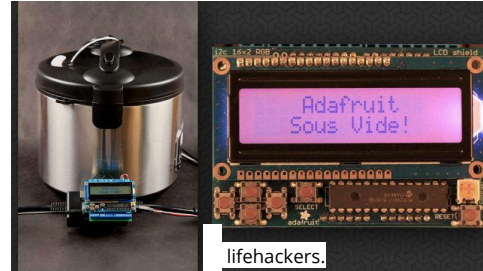


# Maker Invitation: Cooking

- The popularity of shows such as the Food Network's show "Chopped" suggests the cooking may be an attractive means to engage people with Making.
- The website "Instructables" frequently displays projects using FYI tools and techniques for cooking.
  - *The Food Lab: Better Home Cooking Through Science* by J. Kenji Lopéz-Alt might engage people with the science and technology of modern cooking.
- Plans for arduino-based immersion cookers are available from Maker websites.
- The Tech Clinic will examine ways in which students and faculty might be engaged in innovative cooking as part of Making on the Campus.



[instructables.com](http://instructables.com)



[lifehackers.com](http://lifehackers.com)

# The Maker Program



A key component of an established Maker program is a Makerspace, a permanent and accessible area of campus open to students and faculty of all interests and disciplines.

The Maker program also requires the ideals of the Maker Movement to be integrated into academic curriculum with the help of administrators and faculty. A faculty advisor of the Movement would be instrumental in fostering this integration.

A program similar to the writing assistant program, the “Maker Assistants (MAs)” would consist of knowledgeable students who can help others get involved in the Maker Movement, and would help bridge the learning gap with some of the technology of the Movement.

*"In my perspective... science and computer science is a liberal art, it's something everyone should know how to use, at least, and harness in their life. It's not something that should be relegated to the 5 percent of the population in the corner. It's something that everybody should be exposed to and everyone should have mastery of to some extent."*

*- Steve Jobs*



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