Creating Maker Spaces in Schools of Art and Design

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Art Center College of Design + Intel® Design School Network
Art and design schools comprise a native community of makers. This community, and studio culture, provides an opportunity to innovate the concepting and design of maker spaces themselves.

Notions of where technology is headed, and how digital making relates to specific emerging areas of art and design, are constantly evolving. Tackling these issues through topical studios, open calls for proposals, and institutional research initiatives leverages the collective brain to envision innovative maker spaces and systems beyond those designed for the generalist user.
Art and Design schools are already centers for making which presents unique challenges and opportunities for the integration of digital making.

The maker space, forged out of DIY and engineering cultures is built upon different traditions.

**Unique challenges**
- Individual disciplines have their own workflows, skillsets, and approaches to making.
- The craft and making traditions of each discipline may contradict the processes and attitudes of digital making.
- Resources for making may be siloed by discipline.

**Unique opportunities**
- Digital making can be embedded within multiple media, making practices, and processes.
- The maker space itself can be designed by its own community of users.
OVERVIEW

Maker Spaces can make technology accessible to non-experts - allowing artists and designers to work in new ways.

Training and peer-to-peer learning are a major part of a maker space’s function, even outside an academic context. Maker spaces are designed for a range of users from the novice to the expert.

<table>
<thead>
<tr>
<th>Hi-Tech</th>
<th>Low Tech</th>
</tr>
</thead>
<tbody>
<tr>
<td>· State-of-the-art, cutting edge, exclusive</td>
<td></td>
</tr>
<tr>
<td>· Commercial-grade, expensive</td>
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</tr>
<tr>
<td>· Requires safety protocols, lock-outs, protective gear</td>
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<tr>
<td></td>
<td>· Accessible</td>
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<tr>
<td></td>
<td>· Consumer-grade, affordable</td>
</tr>
<tr>
<td></td>
<td>· Easy to learn, STEM/STEAM-oriented</td>
</tr>
</tbody>
</table>
Digital making can play a role within a range of art and design making practices.

**OVERVIEW**

Digital making can play a role within a range of art and design making practices.

**Production**
Highlights refinement of formal design, fidelity, and quality of form and finish. Often informed by industry standards. Requires explicit training, learning, and time.

**Prototyping**
Making as an intermediary step in the iterative design process; meant to be evaluated, revised, and redone. Focus is on testing or demonstrating particular aspects of use.

- May range from low to high fidelity
- Requires persistent setup and storage to enable iteration. Deployment spaces, areas set-aside for testing.

**Experimentation**
"Playing around" without a particular endpoint in mind, to "see what happens." Includes testing and developing techniques and processes.

- Proximity or co-location of different types of making/materials. Possibility of being wet, messy, hazardous, etc.

**Working Knowledge**
Engaging in a making process enough to be able to work, appreciate, and communicate knowledgeably with future collaborators in the area.
Maker Spaces are ecosystems that depend as much on community, staffing and programming as technology and equipment.

Integrating a maker space into the making culture of an art and design school is best done iteratively, allowing it to grow organically in response to evolving community needs. For maker spaces at all scales, the patterns of use – from bottlenecks to improvised workflows – are data for continuously innovating program and process.
The most successful ecosystems develop organically over time, not through top-down design. Therefore, this report encourages working from the bottom-up by putting the pieces in place for a space to grow, and looking for the moments of inflection that indicate a space/initiative that is ready to transition to another scale.
Creating Maker Spaces in Schools of Art and Design

OVERVIEW

At Art and Design Schools, maker spaces are great design projects.

Graduate Transportation UX Studio
Art Center College of Design

• Brief: Development of concepts and designs for vehicular interior “simulator” / prototyping platforms
• Redefinition of the established notion of a “simulator,” moving from quantitative data collection to qualitative (but rigorous) observation and experience
• Research and analysis including proposal for industry partnerships and system models for implementation and use
• Positioning the simulator not as a means of end-testing design, but as the site for the design process itself, with prototyping as a fundamental component
• Maker space results: modular systems of UX simulations including screens, projection, physical user interface inputs and outputs, and enclosed vehicular interior

Future Makerspaces
Royal College of Art

• Visioning for future makerspaces and their role in distributed manufacturing
• 2-year research initiative
• Includes all stakeholders in the value chain: equipment suppliers to product manufacturers, end-users, and the broader community
• Symposia, workshops, and funded feasibility projects
• Maker space results: Circular Makespaces address issues of materiality, reuse, and repair (link)
• Maker space results: Deals with maker spaces as individual entities; local networks; digitally connected networks; and national/international phenomena

Beyond the “starter” maker space, which is fast becoming a fundamental need, there is a real design challenge and opportunity to define next-level maker spaces, including: systems and networks of multiple spaces and labs for highly specialized types or modes of making.
OVERVIEW

About this Report

In 2015 Intel® funded a study into the unique challenges of maker spaces in art and design schools, environments that see themselves as the natural home of “making” of all kinds.

Research began at Art Center College of Design as a home base and primary in-depth case study. At Art Center, departments have strong identities and well-established methodologies, practices and approaches, many of which are strongly informed by industry. Various levels of technological making exists among departments, from very defined workflow to open-ended/experimental. The school is entering an era of expansion with an ambitious Master Plan, and aiming for more cross-departmental resources and cross-pollination through the establishment of a network of maker spaces.

Maker spaces outside of the educational context were also surveyed, with a particular focus on exploring different models of programming, membership, and funding. What each space had in common was the use of making as a design TOOL (not product), and a preoccupation with how to be self-sustaining: financially, and in the cultivation of a strong enough user base to support and justify the maker space’s existence.

Training and education was a large part of each space’s function, although not all were in an academic context. Most aimed, as an explicit component of their mission, to make technology accessible – not just physically, but functionally.

More than the particulars of physical space and equipment, we found that the most essential element of a successful maker space was its community and the ecosystem of users (both learners and leaders), programming, and curriculum.

Integrating digital making into the established making traditions of art and design can lead to exciting hybrids and interdisciplinary collaborations. What follows are guidelines to help others determine the right scale, model, equipment, and philosophy to build a maker space unique to their home institution.
OVERVIEW

Contents of this report

Overview p.2
The unique challenge of digital making in art and design schools.

Case Studies p.12
Maker Spaces in California - a survey.

Guidelines p.20

**Makerspace Ingredients p.21**
A breakdown of key attributes that define a makerspace.

**Recipes p.22**
Configuration outlines for typical maker space growth in a design school context.

**Ingredients Breakdown p.26**
The primary ingredients of a maker space are community, structure, pedagogy, space and equipment. We outline the attributes of each and provide a framework for positioning a maker space with regards to those factors.
How to use this report

We have organized this report around what we see as the primary “ingredients” that go into a maker space: community, structure, space, and equipment. Pedagogy is also a primary ingredient that is specific to maker spaces in the art and design school context. We break each ingredient down further into key attributes.

There is no generic “optimal” setting for each factor; how a space fulfills a certain factor is highly context-specific. Our Case Studies hint at how particular combinations of factors result in spaces with very specific characteristics.

Our Recipes formalize some of the patterns and mechanisms we saw across multiple case studies; configurations of design factors that allow a certain activity to be performed, or a need to be met.

In general, but for a design school in particular, there is a progression from ad-hoc making to more established, dedicated, and staffed spaces. Depending on the existing level of interest and established maker space we offer several models: The Pop-Up; the Starter Lab; the Integrated Lab; and the Institutional Network.
CASE STUDIES

- OPEN
- FLEXIBLE
- INSPIRING
## CASE STUDIES

### Makerspace

<table>
<thead>
<tr>
<th>Noisebridge</th>
<th>Techshop</th>
<th>Autodesk Pier 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007, San Francisco</td>
<td>2006, San Francisco</td>
<td>2013, San Francisco</td>
</tr>
</tbody>
</table>

### Summary

- **Noisebridge**
  - Truly open access, includes set procedure for anyone present in the space to buzz people (anyone) in and orient newcomers
  - Stated orientation is "do-ocracy" and single rule is "be excellent to each other"
  - Actively used space at all hours, with diverse users.
  - Doctoral student in botany had built growing (plant) systems, was learning electronics from another member through collaborating on an automated living wall
  - Collective project to build a pic-n-place machine, acts as collaborative effort and also will be major equipment addition
  - Supports a tor server for access by journalists in censored countries

- **Techshop**
  - Makerspace as commercial-level production facility/factory
  - Explicit entrepreneurial agenda
  - 24-hour staffed access
  - Leading for-profit makerspace, with robust membership, but explores multiple business models beyond membership
  - Equipment included extremely high-tech MagPrinter, for printing superstrong (and very technical and abstract) Polymagnets. The printer was provided by the manufacturer as a way to see what potential applications might be.
  - Open workspace area had lots of natural light and was very actively used

- **Autodesk Pier 9**
  - Makerspace as interface between makers/artists and software company
  - Artist-in-residence program
  - Staff includes public programs manager
  - Most high-tech and well-equipped space surveyed
  - Artists in residence work on their own projects at Pier 9 and are required to post any work on instructables (owned by autodesk)
  - Pier 9 acts as a testing area for autodesk software
  - Autodesk employees also use Pier 9 for in-house product prototyping and personal making

### Access:

- **Noisebridge**: Open
- **Techshop**: Open (fee-based)
- **Autodesk Pier 9**: Closed (invitation only)

### Membership:

- **Noisebridge**: Free/donation suggested
- **Techshop**: Fee-based
- **Autodesk Pier 9**: Artists-in-residence, staff

### Involvement:

- **Noisebridge**: Dedicated
- **Techshop**: Dedicated
- **Autodesk Pier 9**: Dedicated

### Staff:

- **Noisebridge**: Hybrid, volunteer
- **Techshop**: Hybrid
- **Autodesk Pier 9**: Fixed

### Support:

- **Noisebridge**: Unstructured
- **Techshop**: Structured, mandatory safety/equipment training
- **Autodesk Pier 9**: Structured, mandatory safety/equipment training

### Outreach/Events:

- **Noisebridge**: Informal, unprogrammed, community TOR (anonymity network)
- **Techshop**: Programmed, open houses
- **Autodesk Pier 9**: Programmed (lectures, gallery exhibitions)

### Specialization:

- **Noisebridge**: Hacking, electronics, hybrid/combined, member-driven
- **Techshop**: Machine tools, woodshop, digital fabrication
- **Autodesk Pier 9**: Hybrid, combined, member-driven

### Philosophy:

- **Noisebridge**: Anarchist, hacker, collectivist, "Do-ocracy"
- **Techshop**: Commercial, entrepreneurial, maker culture
- **Autodesk Pier 9**: Maker culture, art practice, user-centered software development

### Business Models:

- **Noisebridge**: Membership fees, corporate partnerships
- **Techshop**: Corporate funding (Autodesk)
- **Autodesk Pier 9**: N/A

### Entrepreneurship/IP:

- **Noisebridge**: Support for small businesses
- **Techshop**: N/A
- **Autodesk Pier 9**: N/A

### Learning Models:

- **Noisebridge**: Peer-to-peer, unstructured
- **Techshop**: Fixed, orientation classes
- **Autodesk Pier 9**: Peer-to-peer, unstructured

### Programming:

- **Noisebridge**: Informal, ask-for-help
- **Techshop**: Formal
- **Autodesk Pier 9**: Formal, orientation sessions

### Scale of work:

- **Noisebridge**: Medium/desktop scale
- **Techshop**: Medium/desktop scale
- **Autodesk Pier 9**: Small/body scale, medium/desktop scale

### Size:

- **Noisebridge**: 3,000 sq. ft.
- **Techshop**: 8,000 sq. ft.
- **Autodesk Pier 9**: 12,000 sq. ft.

### Permanence:

- **Noisebridge**: Fixed
- **Techshop**: Fixed
- **Autodesk Pier 9**: Fixed

### Library:

- **Noisebridge**: N/A
- **Techshop**: Books, materials
- **Autodesk Pier 9**: Books, scrap electronics, N/A (bookstore)

### Virtual Space:

- **Noisebridge**: Website, wiki
- **Techshop**: Website, calendar
- **Autodesk Pier 9**: Website, instructables

### Lighting:

- **Noisebridge**: Natural, ceiling lights, floor lamps
- **Techshop**: Ceiling lights, natural rights
- **Autodesk Pier 9**: Natural, ceiling lights

### Storage:

- **Noisebridge**: Lockers
- **Techshop**: Offices, shelves, workspace, open plan
- **Autodesk Pier 9**: Unlabeled

### Layout:

- **Noisebridge**: Workshop, workspace, open plan
- **Techshop**: Sectioned (shops, workspaces, offices)
- **Autodesk Pier 9**: Sectioned (shops, workspaces, offices)

### Equipment:

- **Noisebridge**: Woodshop (tablesaw, miter saw, drill, sander)
  - Three (3) 3D Printers
  - Garden area
  - Four (4) sewing machines
  - Scrap electronics area
  - SMT pick-and-place machine
  - Media production workstation
  - Library, board games
  - Tabletops, workstations, desktop computers, printers
- **Techshop**: Manual mills, CNC mills, routers, metal lathe
  - MIG, TIG, gas, arc and spot welders
  - CNC plasma cutter
  - Oscilloscopes
  - Laser cutters / engravers
  - 3D printers
  - Industrial and consumer-grade sewing machines
  - Cutting table, work tables, desktop computers, large-format printers
  - Material shop (plywood, lumber, etc.)
- **Autodesk Pier 9**: CNC machines
  - Waterjet
  - 5-axis router
  - 3D printers
  - Metal and wood shops
  - Electronics lab
  - Consumer-grade sewing machines
  - Work tables, desks, large format printers, desktop computers
  - Autodesk software
  - Kitchen

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Creating Maker Spaces in Schools of Art and Design
### Makerspace: Noisebridge
- **Year**: 2007, San Francisco
- **Website**: [http://www.noisebridge.net](http://www.noisebridge.net)

### Makerspace: Techshop
- **Year**: 2006, San Francisco
- **Website**: [http://www.techshop.ws/](http://www.techshop.ws/)

### Makerspace: Autodesk Pier 9
- **Year**: 2013, San Francisco
- **Website**: [http://www.autodesk.com/pier-9](http://www.autodesk.com/pier-9)
## CASE STUDIES

### Makerspace

#### Hybrid Lab at CCA

**2012, San Francisco**

[https://www.cca.edu/about/administration/studio-resources/hybrid](https://www.cca.edu/about/administration/studio-resources/hybrid)

<table>
<thead>
<tr>
<th>Summary</th>
<th>The LAB (LA Biohackers)</th>
<th>Maker City LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Multidisciplinary in academic context</td>
<td>- Makerspace as interface between general public and scientists</td>
<td>- Makerspace as post-graduate resource for nearby schools (fidm, usc, etc.)</td>
</tr>
<tr>
<td>- Workspace/social space for students</td>
<td>- Platform for incorporating science into everyday life</td>
<td>- Neighboring communities such as usc and fidm (fashion institute) provide much of their user base</td>
</tr>
<tr>
<td>- Many of the most meaningful/high-impact decisions contributing to</td>
<td></td>
<td>- Different levels of membership: tenant, workspace memberships at varying access levels, single-day passes</td>
</tr>
<tr>
<td>success of the space were in spatial details such as: table height;</td>
<td></td>
<td>- Makerspaces (the sound and stage recording rooms, the sewing atelier) are a draw for the fixed tenants</td>
</tr>
<tr>
<td>casters; light quality (higher brightness than usual)</td>
<td></td>
<td>- Many staffing and tech support / consulting roles are filled by tenants</td>
</tr>
<tr>
<td>- Lab manager's (Andrew) open attitude and personality deemed a key</td>
<td></td>
<td>- Will be the site of techshop la, in large part because of centrality and visibility of building in downtown LA</td>
</tr>
<tr>
<td>factor in the success of the space and its community</td>
<td></td>
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<tr>
<td>- Andrew also an active user of the space, building his own projects</td>
<td></td>
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<tr>
<td>and posting tutorials on their development</td>
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</tr>
</tbody>
</table>

#### The LAB (LA Biohackers)

**2010, Los Angeles**

[http://www.the4lb.com/](http://www.the4lb.com/)

#### Maker City LA

**2010, Los Angeles**


<table>
<thead>
<tr>
<th>Access: Closed (academic)</th>
<th>Open</th>
<th>Open (fee-based)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membership:</td>
<td>Students, faculty, staff</td>
<td>Free/donation suggested</td>
</tr>
<tr>
<td>Involvement: Dedicated</td>
<td></td>
<td>Fee-based</td>
</tr>
<tr>
<td>Staff: Fixed</td>
<td>Volunteer</td>
<td>Dedicated</td>
</tr>
<tr>
<td>Support: Unstructured, drop-in advisory sessions</td>
<td>Structured, ask-for-help</td>
<td>Dedicated</td>
</tr>
<tr>
<td>Outreach/Events: Informal, unprogrammed</td>
<td>Programmed, meetups</td>
<td>Unstructured, peer-to-peer</td>
</tr>
<tr>
<td>Specialization: Hybrid/combined, member-driven</td>
<td>Hybrid, combined, member-driven</td>
<td></td>
</tr>
<tr>
<td>Philosophy: Maker culture, electronics prototyping</td>
<td>Citizen science, DIY biohacking</td>
<td>Maker culture, entrepreneurship</td>
</tr>
<tr>
<td>Business Model: N/A (academic)</td>
<td>Donations</td>
<td>Fee-based</td>
</tr>
<tr>
<td>Entrepreneurship/IP: N/A</td>
<td>Support for small businesses, co-working spaces</td>
<td></td>
</tr>
<tr>
<td>Curriculum Integration: Classes, extracurricular research, project</td>
<td>N/A (General Assembly/education space on site)</td>
<td></td>
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<tr>
<td>development</td>
<td></td>
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<tr>
<td>Learning Models: Traditional, peer-to-peer</td>
<td>Traditional, tutors, community liaisons</td>
<td></td>
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<tr>
<td>Programming: Informal, ask-for-help</td>
<td>Informal, ask-for-help</td>
<td>Unstructured, peer-to-peer</td>
</tr>
<tr>
<td>Scale of work: Small/body scale, medium/desktop scale</td>
<td>Formal</td>
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</tr>
<tr>
<td>Size: 1,000 sq. ft.</td>
<td>Fixed</td>
<td>Fixed</td>
</tr>
<tr>
<td>Permanence: Fixed</td>
<td>Ceiling lights, desk lamps</td>
<td></td>
</tr>
<tr>
<td>Library: Electronics, manuals</td>
<td>N/A</td>
<td>Offices, lockers</td>
</tr>
<tr>
<td>Virtual Space: Website, instructables</td>
<td>N/A</td>
<td></td>
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<tr>
<td>Lighting: Natural, ceiling lights</td>
<td>N/A</td>
<td></td>
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<tr>
<td>Storage: Shelves</td>
<td>N/A</td>
<td></td>
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<tr>
<td>Layout: Workspace, open</td>
<td></td>
<td></td>
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<tr>
<td>Equipment:</td>
<td></td>
<td></td>
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<tr>
<td>- Arduinos &amp; shields</td>
<td>- Microscopes</td>
<td>Media Lab</td>
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<tr>
<td>- 3D printer</td>
<td>- Centrifuge</td>
<td>- Podcasting studio</td>
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<tr>
<td>- PCB mill</td>
<td>- Electrophoresis gel box</td>
<td>- Green screen stage</td>
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<tr>
<td>- Multimeters, oscilloscopes</td>
<td>- Electrophysiology station</td>
<td>- Edit bays</td>
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<tr>
<td>- Power supplies</td>
<td>- Gel documentation system</td>
<td>- Lighting, camera, audio equipment for rent</td>
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<tr>
<td>- Soldering stations</td>
<td>- Electrophoresis power supply</td>
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<tr>
<td>- Various electronic components (resistors, capacitors, LEDs, ICs,</td>
<td>- Heating stir plate</td>
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<tr>
<td>wire, etc.)</td>
<td>- Ventilation hoods</td>
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<tr>
<td>- Tablets (iOS &amp; Android)</td>
<td>- LED grow light panels</td>
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<td>- Webcams</td>
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<td>- Microsoft Kinect</td>
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<tr>
<td>Makerspace</td>
<td>Description</td>
<td>Location</td>
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<tr>
<td>Makerspace</td>
<td>World Building Lab at USC</td>
<td>LA Makerspace</td>
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</tbody>
</table>

**Summary**
- **World Building Lab at USC**
  - Pop-up/nomadic makerspace
  - STEAM educational partnership with Los Angeles Public Library system
  - Scratch Squad programming team
  - Minecraft workshops
- **LA Makerspace**
  - Multidisciplinary in academic context
  - Workspace/social space for students

### Access:
- **World Building Lab at USC**: Closed (academic)
- **LA Makerspace**: Open
- **MDP Making Lab**: Closed (academic)

### Membership:
- **World Building Lab at USC**: Students, faculty, staff
- **LA Makerspace**: Free
- **MDP Making Lab**: Students, faculty, staff

### Involvement:
- **World Building Lab at USC**: Dedicated
- **LA Makerspace**: Casual
- **MDP Making Lab**: Dedicated

### Roles:
- **World Building Lab at USC**: Fixed
- **LA Makerspace**: Hybrid
- **MDP Making Lab**: Fixed

### Staff:
- **World Building Lab at USC**: Volunteer
- **LA Makerspace**: Fixed
- **MDP Making Lab**: Fixed

### Support:
- **World Building Lab at USC**: Structured
- **LA Makerspace**: Unstructured, drop-in advisement sessions, workshops, etc.
- **MDP Making Lab**: Unstructured, drop-in advisement sessions, workshops, etc.

### Outreach/Events:
- **World Building Lab at USC**: Workshops, classes, meetups
- **LA Makerspace**: N/A
- **MDP Making Lab**: N/A

### Specialization:
- **World Building Lab at USC**: Media/game design
- **LA Makerspace**: Computer programming (Scratch, Minecraft, etc.)
- **MDP Making Lab**: Hybrid/combined, student-driven

### Business Model:
- **World Building Lab at USC**: Corporate partnerships
- **LA Makerspace**: Donations
- **MDP Making Lab**: N/A (academic)

### Curriculum Integration:
- **World Building Lab at USC**: Classroom and production space
- **LA Makerspace**: N/A
- **MDP Making Lab**: N/A

### Learning Models:
- **World Building Lab at USC**: Traditional, structured
- **LA Makerspace**: Traditional, structured
- **MDP Making Lab**: Unstructured, peer-to-peer

### Programming:
- **World Building Lab at USC**: Curriculum, research
- **LA Makerspace**: Curriculum, research
- **MDP Making Lab**: Informal, ask-for-help

### Size:
- **World Building Lab at USC**: 4,000 sq. ft.
- **LA Makerspace**: N/A
- **MDP Making Lab**: 1,000 sq. ft.

### Permanence:
- **World Building Lab at USC**: Fixed
- **LA Makerspace**: Pop-up, nomadic
- **MDP Making Lab**: Fixed

### Library:
- **World Building Lab at USC**: N/A
- **LA Makerspace**: N/A
- **MDP Making Lab**: Manuals, etc.

### Virtual Space:
- **World Building Lab at USC**: Website, virtual reality space
- **LA Makerspace**: Website
- **MDP Making Lab**: Website

### Lighting:
- **World Building Lab at USC**: Ceiling lights, gantry lights
- **LA Makerspace**: Ceiling lights
- **MDP Making Lab**: Workshops

### Storage:
- **World Building Lab at USC**: N/A
- **LA Makerspace**: N/A
- **MDP Making Lab**: N/A

### Layout:
- **World Building Lab at USC**: Open, stage
- **LA Makerspace**: N/A
- **MDP Making Lab**: N/A

### Equipment:
- **World Building Lab at USC**:
  - Laser cutter
  - 3D printers
  - Electronics (Arduino, etc.)
  - PC laptops
  - Arts and crafts supplies
  - Filmmaking studios
- **LA Makerspace**:
  - Laser cutter
  - 3D printers
  - 3D scanner
  - Electronic components (Arduino, sensors, shields, resistors, capacitors, LEDs, ICs, wire, etc.)
  - Oscilloscope
  - Soldering stations
  - Machine tools
  - Power tools (cordless drills, sander, jigsaw)
  - Computers, displays, speakers, etc.
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## CASE STUDIES

### Makerspace

| Access | Membership | Involvement | Roles | Staff | Support | Outreach/Events | Specialization | Philosophy | Business Model | ENTREPRENEURSHIP/IP | Curriculum Integration | Programming | Scale of work | Size | Permanence | Library | Virtual Space | Lighting | Storage | Support | Equipment |
|--------|------------|-------------|-------|-------|---------|---------------|---------------|-------------|-------------|-----------------|----------------------|-------------------|-------------|-------------|------|-----------|--------|-------------|---------|--------|---------|-----------|
| Closed (academic) | Students, faculty, staff | Dedicated | Hybrid | Dedicated, semi-fixed (adjunct faculty, grad students, as needed) | Structured | Open calls (to academic community) for project, workshop, and course proposals | General | Cross-departmental collaboration | N/A | N/A | Structured but hybrid, open via calls for proposals | N/A | N/A | Body, tabletop, furniture | N/A | Fixed | N/A | N/A | Ceiling lights | N/A | Bedroom | N/A | Embroidery machine |

### Co-Works Lab at RISD

Rhode Island

http://info.risd.edu/co-works/

http://academicaffairs.risd.edu/faculty-teaching/teach/technology/risd-co-works/

http://academicaffairs.risd.edu/2015/01/co-works-2015-projects/

- Interdisciplinary fabrication lab explicitly for fostering and hosting cross-departmental collaboration
- Programming and access to lab done through open calls for proposals
- Workshops, research and collaborative projects
- Equipment includes 3D printing, 3D scanning, a range of CNC equipment, laser cutting, vacuum forming, machine embroidery and knitting, industrial sewing, foam cutting, UV and large format printing

Excerpt from the document:

```
- Embroidery machine
- Knitting machine
- Industrial sewing machines
- UV and large-format printer
- 3D scanner and printer
- CNC equipment
- Laser cutter
```

Website: http://info.risd.edu/co-works/

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Rhode Island Co-Works Lab at RISD
Makerspace Ingredients

**Community**
The core community of a makerspace is its members and users. In some cases, staff or instructors provide guidance and support, either in fixed or flexible roles. In all cases, collaboration and peer-to-peer learning, networking, and outreach are key.

**Structure**
Philosophy, membership model, business model, and specializations.

**Pedagogy**
Makerspaces provide not just physical access, but also training and instruction on tools and technologies - either through formal instruction, demos, and workshops, or through collaboration among members.

**Space**
Choices about spatial layouts and arrangements and other environmental factors.

**Equipment**
Makerspaces provide access to tools and technology that would otherwise be outside the reach of the community.
Creating Maker Spaces in Schools of Art and Design

GUIDELINES: RECIPES

Popup

Small-scale, iterative/itinerant makerspaces, best for demonstrating that a community interest exists and for identifying the types of specializations, access models, and resources that would best serve that community.

Examples:

Bruce Hubbard's Electronics Lab, The Annex, Hillside Campus
Sewing Lab, 950 Building, South Campus

Makerspace: Popup

500 - 1,000 sq. ft.
- Equipment storage (locked cabinets)
- Mobile workspaces (wheeled carts)
- Flexible floor plan

Closed
- Specialized
- Combined/Hybrid

Small/Body

Makerspace: Pop-up

500 - 1,000 sq. ft.
- Equipment storage (locked cabinets)
- Mobile workspaces (wheeled carts)
- Flexible floor plan

Closed
- Specialized
- Combined/Hybrid

Small/Body
Creating Maker Spaces in Schools of Art and Design

GUIDELINES: RECIPES

General Starter Lab

Transitioning from pop-up and single-person-driven resources to a fixed and more self-sustaining iteration of the makerspace. Often serves an existing while also creating the potential for growth in interest and outreach.

Examples:

CCA Hybrid Lab, California College of the Arts, San Francisco

GUIDELINES: RECIPES

General Starter Lab

Transitioning from pop-up and single-person-driven resources to a fixed and more self-sustaining iteration of the makerspace. Often serves an existing while also creating the potential for growth in interest and outreach.

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GUIDELINES: RECIPES

Integrated Starter Lab

A tightly integrated maker space is one that plays an explicit role in most of a program’s curriculum, through a combination of direct curricular integration and drop-in project support.

Integration of makerspace in curriculum demands more fixed resources (Permanence–Fixed) and full-time staff (Staff–Dedicated).

Examples:

MDP Making Lab, Art Center College of Design

At the institutional level, multiple integrated labs may serve the community, but in a siloed, non-cross-departmental manner.

To support deeper making, regular office hours and mentorship are necessary.

A tight-knit community and controlled space allow students to have a sense of ownership/authorship of the space.

GUIDELINES: RECIPES

Integrated Starter Lab

1,000 - 2,000 sq. ft.

- Close proximity to (or spatially embedded into) studio and teaching spaces.
- Large-scale project storage (table space, floor space)
- Layout that allows for workshops, as well as more formal teaching arrangements
- Permanent, secured storage (locked cabinets)
Institutional Network

Multiple makerspaces across a larger institution, each with its own specializations, but with each still serving the entire community. The redistribution of resources may result in each individual makerspace embodying characteristics of the “Pop-Up Lab” or “Starter Lab”.

GUIDELINES: RECIPES

Makerspace:
Institutional Network

Based on natural affinities and proximities between specialties

Should be driven by the needs of each space, rather than mandated from above

(Specialization–Fixed) Each makerspace is uniquely situated to serve the needs of its department, but the makerspaces are not isolated or siloed.

(Specialization–Electronics) is often a core universal type of technological making that’s applicable to most areas, and may be duplicated in multiple makerspaces

Multiple makerspaces across a larger institution, each with its own specializations, but with each still serving the entire community. The redistribution of resources may result in each individual makerspace embodying characteristics of the “Pop-Up Lab” or “Starter Lab”.

GUIDELINES: RECIPES

Institutional Network

1,000 - 2,000 sq. ft.
May cluster or merge according to scale of making
Community

What is a Makerspace community?

Creation and cultivation of community is the most important ingredient for any self-sustaining makerspace. The members, users, staff, and supporters of a makerspace facilitate peer-to-peer learning, encourage participation, and provide an incentive for others to be in, and actively use, the space. Strong community is also a prerequisite for any model of distributed or shared maintenance or management.

Attributes of a community:

Access, Members, Events, Staff, Roles
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GUIDELINES: INGREDIENTS BREAKDOWN

COMMUNITY → Access

How the community (whether members, potential members, or casual followers) interfaces and interacts with the space has repercussions on its potential for growth, the type of work that it enables, and the overall impression of how it serves those around it.

- **General Public** (free, accessible across multiple departments—may not be all)
  - More diverse membership; allows for self-selection of motivated members of the public; maximizes use; potential for the unexpected

- **Open** (fee-based, accessible cross-institution)
  - Interdepartmental access: accessible across multiple departments
  - Membership through initial training or personal familiarity

- **Closed** (invitation-only, limited to department or sub-community)
  - Based on company affiliation or invitation only

- **Autodesk Pier 9**
  - Artist-in-residency program; presentations and shows
  - Serves narrow audience; insularity
  - Leverages and reinforces existing community (requires less community-building); may be more cohesive/stable; members pre-vetted for responsibility, etc.

- **CCA Hybrid Lab**
  - More fragmented membership base; logistically more complex; vulnerable to abuse
  - Serves narrow audience, insularity
  - Leverages and reinforces existing community (requires less community-building); may be more cohesive/stable; members pre-vetted for responsibility, etc.

- **MakerCity LATechShop**
  - More fragmented membership base; logistically more complex; vulnerable to abuse
  - Serves narrow audience, insularity
  - Leverages and reinforces existing community (requires less community-building); may be more cohesive/stable; members pre-vetted for responsibility, etc.

- **TechShop**
  - More fragmented membership base; logistically more complex; vulnerable to abuse
  - Serves narrow audience, insularity
  - Leverages and reinforces existing community (requires less community-building); may be more cohesive/stable; members pre-vetted for responsibility, etc.

- **Noisebridge**
  - More fragmented membership base; logistically more complex; vulnerable to abuse
  - Serves narrow audience, insularity
  - Leverages and reinforces existing community (requires less community-building); may be more cohesive/stable; members pre-vetted for responsibility, etc.
GUIDELINES: INGREDIENTS BREAKDOWN

COMMUNITY → Members

The most robust and sustainable communities have members across the full spectrum of involvement, from casual to "ownership." Establishing that variety, especially on the dedicated end, requires various strategies.

**Casual**
Passerby, single event attendance, audience, light exposure to tech.

**Novice**
Beginning to learn about tech

**Dilettante**
Novice and project-specific interests often provide fresh take on emerging areas

**Expert**
Feels a sense of ownership of space; takes on maintenance roles

**Investor**
Has a financial/professional/vocational stake in space

**Mentor**
Imparts knowledge to peers; explores independently; has "expertise"

**Dedicated**
Active, visible, ambassadorial

Casual users provide the flow for new membership intake, and act as audience for makerspace activities and events. Casual users provide the flow for new membership intake, and act as audience for makerspace activities and events.

**Machine Project**
hosts one-time installations, lectures, performances, screenings, tours, workshops, etc. Constantly changing teachers and topics encourages a shifting audience and user group.

**Techshop**
Each piece of equipment requires specific training before use, encouraging a consistent and dedicated user group.

**BlowThingsUp Lab**
(Colorado University Boulder)
membership is by application, including the question: "What will you give back to the BTU Lab?"

Advocates for the space, helps drive vision and growth.
## COMMUNITY → Events

### Autodesk Pier 9

- **Open Houses**: All visitors are welcome, informational, introduction to the space, what it offers, who are the members.
- **Workshops**: A meeting at which a group of people engage in intensive discussion and activity on a particular subject or project.
- **Meetups**: Members find and join groups unified by a common interest.
- **Classes**: Meeting regularly to study a subject under the guidance of a teacher or someone with expertise.
- **Hack-A-Thons**: A large number of people meet to engage in collaborative making.

- **Engagement with general community as audience, participant, and potential user/member**
- **Operates as a restaurant that is open to the public**
GUIDELINES: INGREDIENTS BREAKDOWN

COMMUNITY → Staff

Whereas academia traditionally reinforces distinctions between staff and faculty, makerspaces often leverage a fluidity between roles to serve the community best across a variety of scales and needs.

Staff personality is key to whether students feel the space and resources are accessible, and how open they are to experimentation, unconventional use, and productive failure.

Makerspaces aim to create their own communities but often find stability supporting existing communities (i.e. students at nearby institutions).

Staff embody maker attitude, and model hacker ethos and process for members. “let’s figure this out together” vs master-apprentice

Light

general maintenance and programming.

Staff may run workshops; role may be taken on by faculty with other responsibilities

Makerspace community members often take on hybrid roles, moving between user and provider, or client and administrator/employee.

Fulltime

in addition to maintenance, provides project support and tech consultation to students (and faculty)

develops and leads workshops and demos; is fully dedicated to space and community
COMMUNITY → Roles

Workshops, fab labs, and other spaces of production often rely on mentor-mentee or agency-client models for both pedagogical and logistical reasons. How the space allows for fluidity across roles will impact how members invest in and engage with the space.

Distinct

- **Clear understanding of “place” within system, clear scope of responsibilities**
- **Predefined roles can limit vision and discourage feeling of ownership**

Hybrid Lab

- **This specific curricular need in Interaction Design department, but also draws students from all college schools**

Undifferentiated

- **Total fluidity, encourages collaboration, self-motivated learning, and potentially new models of collaboration/learning**

Maker City LA

- **Tenants also fill positions as stage managers and sound production consultant**

Techshop

- **Arizona State University partnership fills need for fabrication equipment and staffing, while local student membership provides automatic user base**

Noisebridge

- **Hackerspace is totally ad-hoc with no required participation, but community members’ exposure to each other results in collaboration (botanist working with engineer on living wall project)**
GUIDELINES: INGREDIENTS BREAKDOWN

Structure

How are Makerspaces Structured?

A successful makerspace responds to specific needs and demands from a community. Therefore, these spaces reflect a specialization of purpose and productive means. Some makerspaces are oriented more towards industrial fabrication, some toward automotive maintenance, some toward film making and set-building. A single makerspace may not be able to satisfy the demands of every single user, so rather than trying to fit every resource into one space (generalization), it may be more effective to implement a network of smaller, more flexible spaces.

Attributes of a Structure:

*Specializations, Philosophy, Business Model and Funding, Entrepreneurship and Intellectual Property (IP)*
GUIDELINES: INGREDIENTS BREAKDOWN

**STRUCTURE → Specialization**

Choices about equipment, spatial configuration, and even the name of the space are important in how they influence perceived intent and use of the space for community members.

- **Required where departments have very different funding structures/sources. Works when there is not a lot of cross-departmental activity.**
- **Works for small institutions/communities, may be necessary as a first-incarnation makerspace. Generally includes 3D fabrication/rapid prototyping and some electronics.**
- **Specialized Combined General**
  - Required where departments have very different funding structures/sources. Works when there is not a lot of cross-departmental activity. Different media and processes have their own dedicated spaces. Allows proximity to most relevant departments. Allows for more specialized and narrower-focus processes and expertise. Natural affinities between specializations can lead to innovative cross-departmental spaces. These affinities might include: shared scale of making overlap of equipment or processes pedagogical overlaps and connections. Strategic combinations of 2 or 3 specializations with natural overlaps can be used for each media separately, or in combination potential for cross-pollination. Wearables Lab
  - Technology + sewing

  - Stop-motion animation "cube" space and open motion-tracking VR space

- **Combined**
  - Natural affinities between specializations can lead to innovative cross-departmental spaces. Strategic combinations of 2 or 3 specializations with natural overlaps can be used for each media separately, or in combination potential for cross-pollination.

- **General**
  - Works for small institutions/communities, may be necessary as a first-incarnation makerspace. Generally includes 3D fabrication/rapid prototyping and some electronics.
GUIDELINES: INGREDIENTS BREAKDOWN

STRUCTURE → Philosophy

<table>
<thead>
<tr>
<th>Entrepreneurship</th>
<th>Academic/Education</th>
<th>Activism/Counterculture</th>
<th>Social Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation</td>
<td>Youth K-12</td>
<td>DIY as reaction to consumer culture and global industrial production</td>
<td>Community engagement</td>
</tr>
<tr>
<td>Business networking</td>
<td>STEM/STEAM</td>
<td>Sewing as antidote to fast fashion</td>
<td>Resourcefulness/low tech</td>
</tr>
<tr>
<td>Rapid prototyping towards</td>
<td>Computational literacy</td>
<td>Upcycling, repair, and repurposing</td>
<td>Sustainability and eco-consciousness</td>
</tr>
<tr>
<td>Minimum Viable Product</td>
<td></td>
<td>Anarchist</td>
<td>(Ex. MDP Field track, ArtCenter Design Matters, TheLab/LA Biohackers)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hacktivism</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Feminism</td>
<td></td>
</tr>
</tbody>
</table>

Techshop
LA Makerspace
Noisebridge
LA Biohackers

Creating Maker Spaces in Schools of Art and Design
GUIDELINES: INGREDIENTS BREAKDOWN

**STRUCTURE → Business Model & Funding**

<table>
<thead>
<tr>
<th>Membership Fees</th>
<th>Class Fees</th>
<th>Subsidized by other business advantages</th>
<th>Retail Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>TechShop</td>
<td>Machine Project</td>
<td>PR and community outreach</td>
<td>Thank You for Coming sells meals, monthly “CSA subscription”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proprietary Process/ Curriculum</th>
<th>Educational Partnership</th>
<th>Cross-promotion</th>
<th>Innovation Partnership business advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>TechShop sells training curriculum and access model to Autodesk</td>
<td>TechShop partnership with Arizona State University (AZ)</td>
<td>Loew’s Home Improvement Store (TX) with TechShop adjacent</td>
<td>SpaceX and Hyperloop educational partnerships/competitions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STRUCTURE → Entrepreneurship / IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the space directly address and support entrepreneurship?</td>
</tr>
<tr>
<td>Documentation - shooting areas, equipment (kickstarter videos)</td>
</tr>
<tr>
<td>User testing/observation areas</td>
</tr>
<tr>
<td>Larger-scope/scale projects that are continuously contributed to by members of the community</td>
</tr>
</tbody>
</table>
GUIDELINES: INGREDIENTS BREAKDOWN

Pedagogy

How is Pedagogy Integrated into Makerspaces?

In an academic context, it is sometimes difficult to classify makerspaces and how they can best be integrated into existing pedagogical practices — whether as classrooms, labs, workshops, or studios. Community makerspaces have traditionally embraced educational models that privilege self-initiated investigation over structured learning. As such, there are a number of approaches that different spaces use to integrate pedagogy.

Attributes of a Pedagogy:

*Curricular Integration, Learning Models, Programming & Scheduling*
GUIDELINES: INGREDIENTS BREAKDOWN

PEDAGOGY → Curricular Integration

Curricula can integrate “making” into courses in one of several ways:

- as shop
- as software training
- as material experimentation
- as sketching/process
- as production

Unique to maker spaces situated in design schools, pedagogy is a primary factor in usage. Makerspaces can support, externalize, and extend curriculum.

Makerspaces become a resource for learning, via workshops/demos and also because they act to consolidate knowledge in a known location. Students can “drop in” for support on more advanced projects/making (even outside of a particular class).
GUIDELINES: INGREDIENTS BREAKDOWN

PEDAGOGY → Learning Models

Expectations regarding demonstrable learning outcomes and methods will influence the programming and use of makerspaces in academic institutions. Makerspaces situated in academic institutions tend to rely on structured learning models more than independent and community-based spaces.
GUIDELINES: INGREDIENTS BREAKDOWN

PEDAGOGY → Programming & Scheduling

In a design school context, how is the maker space itself programmed/scheduled to address both structured and unstructured use?

**Makerspace as Classroom**

- Requires space
- Flex layout or dedicated class/demo area for appropriate table configuration
- Specific presentation/demo equipment: projection or large monitor
- Camera for view of hands-on allows immersion in maker space
- Is another type of space programming while class is in session
- Limits access to non-class users

**Satellite / Mobile Making**

- Equipment checked out of maker space for use in a separate (remote) classroom
- Allows maker space to remain accessible to others
- Only works with portable/small-scale equipment
- Specially designed mobile carts or pods

Examples:

- CMTEL Material carts
- CCA Electronics carts
GUIDELINES: INGREDIENTS BREAKDOWN

Space

Spatial Qualities of Makerspaces

The location and physical layout of a makerspace guides its usage. Characteristics such as working surfaces, lighting, acoustics, storage space, visibility, and accessibility are fundamental to the community’s reception and adoption of a space and the type of work that it will support.

Attributes of Space:

*Physical Scale, Operation Scale, Location*
GUIDELINES: INGREDIENTS BREAKDOWN

SPACE → Physical Scale

<table>
<thead>
<tr>
<th>Small/Body</th>
<th>Medium/Furniture</th>
<th>Large/Architectural</th>
</tr>
</thead>
<tbody>
<tr>
<td>• electronics</td>
<td>• furniture</td>
<td>• wall and facade-scale media</td>
</tr>
<tr>
<td>• wearables</td>
<td>• desk</td>
<td>• reactive spaces</td>
</tr>
<tr>
<td>• sewing/soft-goods:</td>
<td>• kiosk</td>
<td>• building fabrication processes</td>
</tr>
<tr>
<td>• accessories and clothing</td>
<td>• vehicular interior</td>
<td>• landscape</td>
</tr>
<tr>
<td>• consumer electronics / devices</td>
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</tbody>
</table>
Creating Maker Spaces in Schools of Art and Design

GUIDELINES: INGREDIENTS BREAKDOWN

SPACE → Operation Scale

Whereas production spaces in academic institutions (like workshops and model shops) have traditionally stressed craft, finish, and material qualities, contemporary makerspaces often enable experimentation and iterative prototyping, especially in technology and digital fabrication.

- Lots of iteration
- Lots of failure
- May have more manual operations
- “Low” tech

Low Fidelity – Prototype

Implementation and fabrication of multiples requires different speed and reliability level equipment (bukobot vs Zcorp 3d printer)

High Fidelity | Production

May require different equipment and skills and buildup over several terms, not a one-course objective.

- more complex systems
- higher level of finish
- sustained experience necessary

Assembly-line model not suited to educational context - outsource production
GUIDELINES: INGREDIENTS BREAKDOWN

**SPACE → Location**

The visibility of the space, its resources, and the work that happens within it are important for how the community is made aware of the space, and how it eventually serves a role in both a social and productive capacity.

**Fixed fulltime space**

- **Dedicated**
  - CMTEL at Art Center
  - Color, Materials and Trends Exploration Lab

- **Fixed shared space**
  - Electronics Cabinets - Art Center Annex
  - Locked, dedicated cabinets hold supplies within a shared classroom

- **Fixed**
  - Thank You For Coming
  - Restaurant as well as makerspace for food

- **Itinerant pop-ups**
  - Curated Materials carts can be put together for a particular class and wheeled to separate classroom

- **Fixed**
  - Rent and staffing directly relate to access and business models

- **Fixed fulltime space**
  - Sharing economy distributes cost and use of resources.

- **Dedicated**
  - CMTEL at Art Center
  - Color, Materials and Trends Exploration Lab
GUIDELINES: INGREDIENTS BREAKDOWN

Spatial Qualities

The fluid activities and open technology-centric mindset of a maker space are a natural fit with web-based platforms for information, documentation, and administration.

- Lab wiki
- Remote webcam or space monitoring (nullspace “Open” sign on webpage)
- Online scheduling (TechShop)
- Signage, quick how-tos, equipment guides and troubleshooting within space
- FAQs
- Online tutorials and demos

Makerspace as hangout space:
- Generally open studio-style
- Large tables, without barriers or dividers
- Line of sight throughout workspace
- Can hang out without any specific thing to work on
- Exposure to other people, other projects

Design of these spaces include:
- Good lighting
- Table heights
- Flexible furniture layout
- Openness (visibility, open door)
- Formal and informal
- Access (key, card)
- Staffing
Capabilities and Capacities that Makerspaces Enable

Makerspaces have emerged in conjunction with significant shifts in material production. While the integration of digital fabrication technologies (i.e. 3D printers and laser cutters) have become characteristic of these spaces, the types of equipment available for users should be informed and driven by the work that the space aspires to enable. The use of the equipment will be driven by other factors, such as community and accessibility.
## EQUIPMENT → Electronics/Physical Computing

### Processes

- Structural fabrication
- Surface finishing
- Enclosure fabrication
- Form making

### Equipment

- Wood and metal shop manual tools (band saw, table saw, etc.)
- 3D printers
- Laser cutters
- CNC router
- Water jet cutter
- Paint and spray booth
- Sandblaster
- Powder-coating enamel oven
- Fumigation hood

### Supplies/Materials

- Plywood sheet
- Metal sheet
- Acrylic sheet
- Bits, blades
- Hardware (screws, nails, etc.)
GUIDELINES: INGREDIENTS BREAKDOWN

EQUIPMENT → Electronics / Physical Computing

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<tr>
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<th>Equipment</th>
<th>Supplies/Materials</th>
</tr>
</thead>
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<tr>
<td>Circuit building and testing</td>
<td>□ Microcontrollers</td>
<td>□ Discrete electronic components</td>
</tr>
<tr>
<td>Hardware hacking (disassembly, testing,</td>
<td>□ Discrete electronic components</td>
<td>□ Solder</td>
</tr>
<tr>
<td>reverse engineering)</td>
<td>□ Soldering iron</td>
<td>□ Wire</td>
</tr>
<tr>
<td>Firmware programming and testing</td>
<td>□ Fume extraction or ventilation</td>
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<tr>
<td></td>
<td>□ Pick-n-place machine (automated component</td>
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<td></td>
<td>placement)</td>
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<tr>
<td></td>
<td>□ PCB fabrication (milling or etching)</td>
<td></td>
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<tr>
<td></td>
<td>□ Hackable/repurposable electronics</td>
<td></td>
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<tr>
<td></td>
<td>□ Power supplies</td>
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<tr>
<td></td>
<td>□ Signal generators</td>
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<tr>
<td></td>
<td>□ Oscilloscopes</td>
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<td>□ Multimeters</td>
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<tr>
<td></td>
<td>□ Breadboards</td>
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**GUIDELINES: INGREDIENTS BREAKDOWN**

**EQUIPMENT → Game Design**

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<thead>
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<th>Processes</th>
<th>Equipment</th>
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<tbody>
<tr>
<td>VR development</td>
<td>□ Console developer kits</td>
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<tr>
<td>User testing</td>
<td>□ Virtual reality technologies (Oculus Rift)</td>
</tr>
<tr>
<td>Digital game development</td>
<td>□ Sensors and game controllers</td>
</tr>
<tr>
<td>Game paper-prototyping and play testing</td>
<td>□ Screen-based software development (Unity, Unreal)</td>
</tr>
</tbody>
</table>
GUIDELINES: INGREDIENTS BREAKDOWN

EQUIPMENT → Sewing / Textile

<table>
<thead>
<tr>
<th>Processes</th>
<th>Equipment</th>
<th>Supplies/Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewing</td>
<td>□ Sewing machines (industrial, hobby)</td>
<td>□ Fabric</td>
</tr>
<tr>
<td>Pattern making</td>
<td>□ Embroidery machines (computerized)</td>
<td>□ Fibers</td>
</tr>
<tr>
<td>Draping</td>
<td>□ Overlock machine</td>
<td>□ Coated fabric (textile printer-specific)</td>
</tr>
<tr>
<td>Cutting</td>
<td>□ Cutting tables</td>
<td>□ Thread</td>
</tr>
<tr>
<td>Textile manipulation</td>
<td>□ Dress forms</td>
<td>□ Pins</td>
</tr>
<tr>
<td>Textile surface design: dyeing, printing</td>
<td>□ Steamer and iron</td>
<td></td>
</tr>
<tr>
<td>Felting</td>
<td>□ Silkscreening frames</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Textile printer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Large sink / water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Loom</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Knitting machine</td>
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</tr>
</tbody>
</table>
GUIDELINES: INGREDIENTS BREAKDOWN

EQUIPMENT → World Building

Processes
- VR development
- Animation
- Set design
- Model making
- Ideation
- System design

Equipment
- Camera tracking (motion-capture) rigged space
- VR technologies
- Stop-motion animation “black box”
- Model-building
- 3D printing
- Set and prop fabrication
- Whiteboard
- Projector and projection area
GUIDELINES: INGREDIENTS BREAKDOWN

EQUIPMENT → Food

Processes
- Gardening/Farming
  - indoor
  - outdoor
  - compost
  - hybridization
- Cooking
- Baking

Equipment
- Sink
- Refrigerator
- Toaster Oven
- Oven
- Hot Plate
- Stove
- Blender
- Cutlery+Utensils
- Dehydrator
- Sous-vide
- Industrial Kitchen

Supplies/Materials
- Ingredients
- Seeds
- Plants
- Soil
## EQUIPMENT → Biohacking

<table>
<thead>
<tr>
<th>Processes</th>
<th>Equipment</th>
<th>Supplies/Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gene sequencing</td>
<td>□ Centrifuge</td>
<td>□ Petri dish</td>
</tr>
<tr>
<td>DNA amplification</td>
<td>□ Electrophoresis gel box</td>
<td>□ Test tube</td>
</tr>
<tr>
<td>Genetic engineering (splicing)</td>
<td>□ Electrophysiology station</td>
<td>□ Agar gel</td>
</tr>
<tr>
<td>Synthetic biology</td>
<td>□ Gel documentation system</td>
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</tr>
<tr>
<td></td>
<td>□ Electrophoresis power supply</td>
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<td></td>
<td>□ Heating stir plate</td>
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<tr>
<td></td>
<td>□ Fumigation hood</td>
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</tr>
<tr>
<td></td>
<td>□ Thermocycler</td>
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</tr>
</tbody>
</table>
CONCLUSION

Guidelines for schools interested in starting a maker space

- Art and Design schools are already centers for making which presents unique challenges and opportunities for the integration of digital making.

- Maker Spaces can make technology accessible to non-experts - allowing artists and designers to work in new ways.

- Digital making can play a role within a range of art and design making practices.

- Maker Spaces are ecosystems that depend as much on community, staffing and programming as technology and equipment.

- Maker spaces can work at a variety of scales, from a single cart to an institution-wide network.

- At Art and Design Schools, maker spaces are great design projects.
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