Maker spaces typically include technology such as 3-D printers, laser cutters, computer design shop tools, and other electronics.

“A gathering place for tools, projects, mentors, and expertise.”
(Graves et. al., 2006)

"Time, talk and tools" + creativity.
(John Dewey)
The Contemporary Maker Movement

1st Maker Class
Dr Neil Gershenfeld, MIT, started a class called How to Make (Almost) Anything, which sparked FabLabs.

1998

First Fab Lab
Started at MIT & was sponsored by NSF. Fab Labs then start popping up around the world.

2001

Make Magazine Premiere
Publication helped brand a movement that built upon the American tradition of self-initiative, DIY & creativity.

2005

1st MakerFaire
Held in San Francisco Bay Area. Hundreds are now held around the world each year.

2006

Before the branding, hobbyists have long been involved with ham radio & remote controlled airplanes.

Radio Shack & others provided components for "pre-makers" to build computers & other electronics, including founders of big dot-coms.
The Contemporary Maker Movement

1st White House Maker Faire
Also, June 18 is designated the National Day of Making

2014

Week of Making
Designated by The White House as June 12-18.

2015

2019 & beyond

More than 2000+ maker, hacker, & fab labs in libraries, schools, hands-on museums & community spaces globally.

Spaces for hobbyists & small-business entrepreneurs

Museums & other places for one-time experience.

Schools or free-standing spaces give extended experiences.

Maker Ed
NATION of MAKERS
Maker pedagogy is rooted in philosophies such as Rousseau’s ideas about the nature of knowledge & Dewey’s ideas about constructivism. They emphasize meaning, active engagement, collaboration and child-centered hands-on experiences in the world to drive learning.

Also extends to constructionism which emphasizes student-centered learning that involves the use of materials or tangible objects.


Ex: problem or project-based learning (PBL)

Schools begin to embrace interest-driven learning as a way to build:

- student interest & creativity
- STEM knowledge,
- STEM self-efficacy,
- design thinking,
- collaboration,
- & other 21st Century Skills.
...many prompted by a Dear Colleague Letter using EAGER

60 maker projects 2013-2018
31 from 2017

7 collaborative projects

Underrepresented Groups

Project Setting

Number of Projects

Number of Projects

Rural  |  Urban  |  African American  |  Latinx
Indigenous  |  Immigrant  |  Female  |  LD/ASD

College  |  HS  |  MS  |  Elem  |  Museum  |  Library
Impacting Communities in 28 States

with innovative technologies & maker projects such as:

1. **Robotics**
   - Ex: Rural library makerspace with robotic telepresence mentors.

2. **Nano-Makerspace**
   - Ex: Microscale structures on butterfly wings.

3. **Bio maker spaces**
   - Ex: Build genetic circuits to modify microorganisms.

4. **VR/AR**
   - Ex: See the flow of electrons in a project you are building.

5. **Workforce development & STEM pathways**
   - Ex: Veteran Maker Workshop

6. **Mobile maker spaces**
   - Ex: Support learning & well-being in a children’s hospital.

7. **PD/Teacher prep**
   - Ex: Immersive MakerSTEM Lab experience to teach content & pedagogy to pre-service educators.

8. **Biomaker spaces**
   - Ex: Build genetic circuits to modify microorganisms.

9. **Mobile maker spaces**
   - Ex: Support learning & well-being in a children’s hospital.
Five Summit Themes

Co-created through collaboration between NSF, EDC/STELAR, and PI's who volunteered for the planning committee.

- Broadening Participation
- Partnerships
- Process & Pedagogy
- Research & Evaluation
- Workforce Development
Connect PIs with colleagues to share ideas and resources, and discuss potential collaborations.

Identify current issues in the Maker movement with respect to education.

Identify important research issues and trends.

Discuss NSF’s investments in the Maker movement.

Recommend future directions for NSF research and development to address challenges.

Charting the Future of Making STEM Education
### Summit Format

Almost entirely participatory, with a few plenary sessions.

#### Monday, December 10

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30</td>
<td>Registration and Breakfast</td>
<td>Pre-function</td>
</tr>
<tr>
<td>8:30</td>
<td>Welcome and NSF opening remarks:</td>
<td>Plenary</td>
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<tr>
<td></td>
<td>Karen Marrongelle, Assistant Director of</td>
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<td></td>
<td>Education &amp; Human Resources Directorate, NSF</td>
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<tr>
<td>9:00</td>
<td>State of the State on Maker Education:</td>
<td>Plenary</td>
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<tr>
<td></td>
<td>Andrew Coy, Digital Harbor Foundation</td>
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<tr>
<td>10:00</td>
<td>Collaboration Break</td>
<td>Pre-function</td>
</tr>
<tr>
<td>10:30</td>
<td>Synthesis Sessions: Round 1</td>
<td></td>
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<tr>
<td></td>
<td>Partnerships</td>
<td>Alexandria</td>
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<tr>
<td></td>
<td>Research and Evaluation</td>
<td>Mt. Vernon</td>
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<tr>
<td></td>
<td>Workforce Development</td>
<td>Potomac</td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch and Table Discussions</td>
<td>Lunch room</td>
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<tr>
<td>1:15</td>
<td>Synthesis Sessions: Round 2</td>
<td></td>
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<tr>
<td></td>
<td>Broadening Participation</td>
<td>Alexandria</td>
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<tr>
<td></td>
<td>Process and Pedagogy</td>
<td>Mt. Vernon</td>
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<td></td>
<td>Workforce Development</td>
<td>Potomac</td>
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<tr>
<td>2:30</td>
<td>Collaboration Break</td>
<td>Pre-function</td>
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<tr>
<td>2:45</td>
<td>Synthesis Sessions: Round 3</td>
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<td></td>
<td>Broadening Participation</td>
<td>Alexandria</td>
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<td></td>
<td>Process and Pedagogy</td>
<td>Mt. Vernon</td>
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<tr>
<td></td>
<td>Research and Evaluation</td>
<td>Potomac</td>
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<tr>
<td>4:00</td>
<td>Collaboration break</td>
<td>Pre-function</td>
</tr>
<tr>
<td>4:15</td>
<td>Synthesis Sessions: Summary and Reflection Activity</td>
<td>Plenary</td>
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<tr>
<td>5:00</td>
<td>Project Expo Set-up</td>
<td>Ballroom</td>
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<tr>
<td>5:30</td>
<td>Project Expo</td>
<td>Ballroom</td>
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<tr>
<td>7:00</td>
<td>Group dinners (self-pay)</td>
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</tbody>
</table>

#### Tuesday, December 11

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Location</th>
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<tbody>
<tr>
<td>7:30</td>
<td>Breakfast</td>
<td>Pre-function</td>
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<tr>
<td>8:30</td>
<td>Welcome and Walkthrough of Day 2</td>
<td>Plenary</td>
</tr>
<tr>
<td></td>
<td>Report out of Day 1 Synthesis Sessions</td>
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<tr>
<td>9:30</td>
<td>Panel: Innovations, Challenges and the Future of Making</td>
<td>Plenary</td>
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<tr>
<td></td>
<td>Liza Manfred, KID Museum</td>
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<td></td>
<td>Erick Jones, University of Texas, Arlington</td>
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<td>Andee Rubin, TERC</td>
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<td></td>
<td>Monya Ruffin, National Science Foundation</td>
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<tr>
<td>10:30</td>
<td>Envisioning Group Selection and Collaboration Break</td>
<td>Pre-function</td>
</tr>
<tr>
<td>11:00</td>
<td>Envisioning Group Sessions</td>
<td>Ballroom</td>
</tr>
<tr>
<td>12:30</td>
<td>Lunch and Envisioning Q&amp;A</td>
<td>Lunch room</td>
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<tr>
<td>1:45</td>
<td>Envisioning Group Sessions</td>
<td>Ballroom</td>
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<tr>
<td>3:00</td>
<td>Collaboration Break</td>
<td>Pre-function</td>
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<tr>
<td>3:15</td>
<td>National Science Foundation Panel: Envisioning Groups Report to NSF</td>
<td>Plenary</td>
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<tr>
<td></td>
<td>Evan Heit, Director, Division of Research on Learning (DRL)</td>
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<tr>
<td></td>
<td>Ellen McDaniel, Program Director</td>
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<tr>
<td></td>
<td>Robert Russell, Program Director</td>
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<tr>
<td>4:15</td>
<td>Close and Next Steps</td>
<td>Plenary</td>
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<tr>
<td>5:00</td>
<td>Project Expo</td>
<td>Ballroom</td>
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<td>7:00</td>
<td>Group dinners (self-pay)</td>
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</table>
Visit the Maker Resource Library

A primary goal of the Summit was to compile a comprehensive bibliography of resources in the Maker field. Thank you to all who submitted resources!

Search the library on our website:

http://stelar.edc.org/maker-resource-library
A 5-part webinar series:

- reporting-out from the event,
- carrying forward the discussion,
- sharing ideas generated at the event,
- fostering further collaboration,
- and connecting with the broader maker community.

Register for the series, or each individual webinar.

https://edc.co1.qualtrics.com/jfe/form/SV_54JytTRamgtjR53
Webinar 1: Workforce Development

Discussed at the Summit:

- Understanding Need
  - skill sets related to jobs
  - location barriers
  - income limitations
  - financial goals
  - use of technology and manual tools
- Transition from maker to workforce sustainability
- Development of skills and collaboration, self-efficacy etc.
- Partnerships with business and industry
- Maker context for unique populations (e.g., veterans)
- Industry/academic/community partnerships
- Certification in IT & other areas
- Authentic experiences

In the Webinar:

Make the Force be With You: Workforce Development through Making

Participants learned how their research in making is related to workforce development as a broader impact or as a direct intervention. This webinar examined how skills developed in making relate to imminent workforce needs. Presenters also discussed the need for longitudinal K-12 systemic preparation for STEM work and learning fields, and the connection between making and the future STEM workforce.

Presenters:
Anthony Dean, Batten College of Engineering and Technology
Gul Okudan Kremer and Richard Stone, Iowa State University

Date: Friday, April 12 from 12-1 pm ET

View the slides & presentation here:

http://stelar.edc.org/sites/stelar.edc.org/files/Presentation Slides.pdf
http://stelar.edc.org/videos/maker-webinar-workforce-development
Webinar 2: Process & Pedagogy

Discussed at the Summit:

- Getting beyond 3D printing & technology
- Traditional schooling vs. making/learning
- What are the most important qualities of making and related pedagogy
- How to scale maker activities in school
- Developing pedagogical maker knowledge of teachers and informal educators
- Connecting making to curriculum & educational standards
- Equity & access in formal education

In the Webinar:

This webinar will discuss how making looks like across different settings such as higher education, informal learning environments, and schools with high and low tech. The focus of the discussion will be pedagogical practices, practical challenges, and opportunities to broaden and sustain the participation of people with diverse backgrounds in Making. The presenters will highlight different aspect(s) of their projects relevant to the discussion.

Presenters:
Yasmin Kafai, University of Pennsylvania
Micah Lande, Arizona State University
Kristin Searle, Utah State University
Sinem Siyahhan, California State University San Marcos

Date: Friday, April 26 from 12-1 pm ET

View the slides & presentation here:
http://stelar.edc.org/sites/stelar.edc.org/files/Final_SlideDeck.pdf
Webinar 3: Research & Evaluation

Discussed at the Summit:

- What should be assessed
- Assessment in school vs maker spaces
- Standards of evidence
- No one-size-fits all methods
- Assessment skills, building capacity, protocols
- View of assessment as antithetical to making
- Researchers, practitioners, and value of research
- Relevant research methods for making activities
- Assessing voluntary maker activities

In the Webinar:

During this webinar we will examine the challenges in designing assessments and measuring cognitive and non-cognitive learning outcomes in a maker-based project.

Presenters:
Jennifer Albert, Citadel Military College of South Carolina
Cynthia Tananis, University of Pittsburgh
David Reider, Education Design

Date: Tuesday, April 30 from 1-2 pm ET

View the slides & presentation here:
http://stelar.edc.org/videos/stelar-webinar-maker-research-evaluation
Webinar 4: Partnerships & Broadening Participation

Discussed at the Summit:

- Co-creation, co-design, responsive
- Community-driven needs, part of community ecosystem, building community capacity
- Grounded in community, community-driven
- Intergenerational, maker ethic at home
- Culturally sustaining approach, culturally responsive making
- Equitable making, attention issues involving gender, communities of color, persons with disabilities, LGBTQ
- Pathways/transition experiences for youthful participants to work

In the Webinar:

In this webinar, learn about individual and group strategies that can help to support your work - current and future. Presenters will highlight both Making Partnerships and Broadening Participation. Essential for most projects, strong partnerships are key to Making because of the scope of outcomes and the distributed expertise present across individuals. In addition to supporting these partnerships, NSF is committed to broadening the participation of those underrepresented in STEM. The research community has an opportunity to address the challenges of understanding key differences of access versus equity, individual and local contexts, and co-creating research with communities. Discussions will include how the making community can work together to develop guiding principles for future research, and generate ideas on how projects can design for transformative change.

Presenters:
Bradley Barker and Dagen Valentine, University of Nebraska-Lincoln
Dorothy Jones-Davis, Nation of Makers

Date: Tuesday, May 14 from 2-3 pm ET

View the slides & presentation here:
http://stelar.edc.org/videos/stelar-maker-webinar-partnerships-broadening-participation
Webinar 5: An NSF Summary of the EAGER Maker Summit

In the Webinar:

NSF Making Partnerships

Join NSF Program Officer Robert Russell and Einstein Fellow Brenda Carpenter for this summative webinar on the 2018 EAGER Maker Summit. The presentation will provide an overview of NSF's commitment to making, review key highlights from the December meeting, and provide a recap of the previous four webinars in our series. Learn more about plans for continuing these conversations, and future opportunities for collaboration.

Presenters:
Robert Russell, NSF Program Officer and Brenda Carpenter, Einstein Fellow

Date: Tuesday, May 21 from 2-3 pm ET
This event was supported by NSF grant # DRL-1614697. Any opinions, findings, and conclusions or recommendations expressed in this event are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Resources
http://stelar.edc.org/NSF-eager-maker-summit
https://curiositycommons.wordpress.com/a-brief-history-of-makerspaces/
http://informalscience.org/
https://nationofmakers.us/resources.html
https://makered.org/resources/

May 21, 2019
Bob Russell, NSF Program Officer
Brenda Carpenter, Einstein Fellow