

Bank Street College of Education Educate

Graduate Student Independent Studies


Spring 5-31-2018

Teens in Queens: Engaging Teens Living in Queens, New York through Museum Partnerships

Emily Gross

Bank Street College of Education, egross@bankstreet.edu

Follow this and additional works at: <https://educate.bankstreet.edu/independent-studies>

 Part of the [Curriculum and Instruction Commons](#), [Other Education Commons](#), and the [Outdoor Education Commons](#)

Recommended Citation

Gross, E. (2018). Teens in Queens: Engaging Teens Living in Queens, New York through Museum Partnerships. *New York : Bank Street College of Education*. Retrieved from <https://educate.bankstreet.edu/independent-studies/214>

This Thesis is brought to you for free and open access by Educate. It has been accepted for inclusion in Graduate Student Independent Studies by an authorized administrator of Educate. For more information, please contact kfreda@bankstreet.edu.

Teens in Queens:
Engaging Teens Living in Queens, New York through Museum Partnerships

By
Emily Gross
Museum Education

Mentor: Cathleen Wiggins

Submitted in partial fulfillment of the requirements of the degree of

Master of Science in Education

Bank Street College of Education

2018

Emily Gross

Teens in Queens:

Engaging Teens Living in Queens, New York through Museum Partnerships

Abstract

The teen program presented in this document was inspired by my own experiences living and attending school in Queens, New York. This program is designed as a museum partnership between the New York Hall of Science, the Queens Museum, and the Queens County Farm Museum, for the benefit of middle school adolescents living or attending school in Queens, New York. This year long program exposes teens to local museums, connecting three different content areas (STEM, art, and agriculture) in museum settings. During the program, teens will engage with their community on a deeper level, learn through skill based activities, explore social issues through art, and gain knowledge of sustainable agriculture. An exhibition displaying a project of their choice will be displayed at the end of the year. This program seeks out three major goals: to meaningfully engage teens in museum settings, establish mentor relationships between teens and museum educators, and to make connections to their communities and everyday lives. This proposal includes how to execute this type of programming, why it is important, along with curriculum and lesson plans.

Table of Contents

I. Introduction	2
II. Goals.....	6
III. Rationale	7
IV. Applications	10
V. Literature Review.....	12
VI. Program Schedule.....	23
VII. Lesson Plans	28
1. Journal Making	28
2. Collaborative Art Making and Personal Object Activity.....	34
3. Composting and Seed Bombing	38
4. What is 3D printing?.....	46
5. Introduction to Tinkercad	54
6. Circuit Boards and Paper Circuits.....	59
7. What’s the Buzz?	65
VIII. Methods of Evaluation.....	68
IX. Reflection.....	71
X. References	74
XI. Appendix.....	76

I. Introduction

Teens in Queens encourages middle school teens to become involved in their local community, and seeks to enhance learning opportunities in museum settings. Students who might not be able to attend museums on their own or otherwise have the opportunity to travel to multiple sites in different content areas. *Teens in Queens* is a program designed for young adolescents which hopes to continue along in the teens lives in a multi-year design aiding in a process of lifelong skill based learning.

Inspired by my own adolescent experiences living and attending school in Queens, New York I rarely had active learning opportunities outside of school. An engaged young learner, I had always loved the process of learning new things. However, when I began middle school my engagement lessened and resulted in a disengagement that continued through high school. Teens living in Queens are exposed to a fast paced city, and in my experience, can often feel isolated. I believe that if I belonged to a program that connected my borough to my life in a meaningful way that I might not have felt so alone. *Teens in Queens* is a program dedicated to my adolescent self, with the hopes of helping other teens who might feel lost in this chaotic city while being fueled by its influential energy.

When designing *Teens in Queens* it was important for me to include the teen perspective and think about the unique borough of Queens. Queens is the most ethnically diverse urban area in the world, with a population of 2,296,175 (U.S. Census Bureau, n.d.). The New York Hall of Science (NYSCI) and Queens Museum are on opposite sides of Flushing Meadows-Corona Park. The Queens County Farm Museum is in Glen Oaks, on a 47-acre parcel, the longest continuously farmed site in New York State (Queens

County Farm Museum, n.d.). Exposing young teens to different geographic locations within the same borough is important because not all teens are able to access areas of the borough due to limits on transportation. In order to access the Queens Museum or the New York Hall of Science, you must take the 7 train and walk approximately 10 minutes until you arrive at Flushing Meadows-Corona Park. If you are a teen living in eastern Queens traveling to either of these museums, your choices are limited and time consuming. If you are a teen trying to access the Queens County Farm Museum, the only way of public transportation is the E or F train, then to transfer to the Q46 bus until you reach the museum. Data collected in 2016 from City-Data shows people living in Queens spend approximately 30-90 minutes traveling to work each day. Majority modes of transportation for people living in Queens are either subway or car. A goal for *Teens in Queens* is to provide teens with stipend support to access each site which will lead to less travel anxiety and enhanced motivation.

The varied content areas of each museum is meant to support subject areas teens might be exposed to in school, or will be exposed to in the coming years. The New York Hall of Science is a museum for STEM exploration, and skills learned in the Maker Space will be valuable lifelong. Students will explore the concepts of additive manufacturing with 3D printers and why circuits are important by creating their own paper circuits after tinkering with circuit blocks. These introductory skills will be useful when the students begin thinking about their own project, and how they can use the skills they learned while in the Maker Space to help their ideas come to life.

The Queens Museum, rooted in art and social justice, will ask young teens to think about contemporary art and artmaking can benefit our local community and larger

society. Collaborative art activities, meeting with art residents, exhibition designers will give the students access to thinking deeply about what it takes to create an art exhibit.

The resident artists at the Queens Museum think about their connections to their communities and can offer the students more information on how to create for your community and why linking art and community is important. The Queens Museum values including themes of social justice in their exhibits, allowing students to meet with exhibition designers gives them an opportunity to see challenges that exhibit designers face and how they relate their exhibits to the Queens community while focusing on social justice. Students will have the opportunity to ask questions and spend time getting to know museum professionals. If students choose to focus their final project at the Queens Museum, artists and exhibit designers will be available to offer assistance and guidance along the way.

The Queens County Farm Museum has unique sustainable agriculture programming that will expose students to farming in a city, and how sustainable agriculture be expanded to their own lives. The Queens County Farm Museum will introduce ideas of composting and building community and school gardens. Students will have the opportunity to bring their new learned skills back to their community and school in order to spread these practices.

The literature review addresses important discussions on why teen programming is important and how to best achieve prolonged engaging programming for museum partnerships. Lesson schedules, unit explanations, developing curriculum and three sample lesson plans are included as building blocks in order to fulfill this type of programming. Evaluation techniques are included as well to help maintain and adapt this

program in future years. It is important to note that while this program is dedicated specifically to teens living in Queens NY, this type of programming can be developed in any community with local museums willing to take on the task of serving its youth population.

II. Goals

This program seeks out three major goals: to meaningfully engage diverse teens in museum settings, communicate with peers and educators, and to make connections to their communities and everyday lives.

ENGAGE

Engage Young People Intellectually, Academically, Socially, and Emotionally

- Program provides first-hand experiences with skills based learning.
- Program engages a diverse group of young people in STEAM learning environments that they are currently (or will eventually be) exposed to in their school setting.
- Program enhances intrinsic motivation within teens.

COMMUNICATE

Young People Communicate Interests, Experiences, and Cultural Practices

- Program will connect as being socially meaningful and culturally relevant.
- Program supports young people to collaborate and to take on leadership roles.
- Program positions staff as co-investigators and learners alongside their students.

CONNECTIONS

Connect Recently Learned Skills to School, Home, and Other Settings

- Program connects learning experiences across settings.
- Program opens doors to new local resources and partnerships for the youth community.
- Program motivates teens to independently continue their learning to further advance their education after the programs end.

III. Rationale

The adolescent population in Queens (ages 14-17) in 2016 was approximately 100,527 (U.S. Census Bureau, n.d.) with 104 middle schools spread across the borough (NYC Department of Education, 2018). In my high school located in Bayside, NY the number of students from the 8th-12th grade exceeded 3,000 students when I graduated in 2002. Overworked teachers, crowded classrooms, state standards focusing on testing instead of motivated learning opportunities, and the general pressure of being a developmentally changing young adult can cause great shifts in academic focus and abilities. Focusing the program on middle school instead of high school students will provide an opportunity for young adolescents to gain opportunities for intrinsic learning possibilities before the stress of state exams and college preparation begins.

“Teens, historically one of the most underrepresented demographics among museum visitors, hold considerable promise for our institutions; teens who get involved are likely to stay involved with arts organizations over their lifetimes, and are likely our best advocates now and in the years ahead” (Sukuma & WY rick, 2014). If teens are valuable to museums, then why are they one of the most underrepresented visitors? One reason could be adult bias towards teens.

An adult bias towards teens might include thoughts of disengagement, disinterest, and disrespect. Assumptions like these can deter a museum from engaging with teens, and this program is designed to dispel the bias of teen emotional instability. While biases exist in everyone, I must acknowledge the myth of teen angst is not just a myth.

Developmentally, barriers exist within this young adolescent period. Once attached to family and concrete ways of thinking, the transition from child to teenager

can be filled with insecurity, consumed by peer pressure and ideas about how you present yourself to the world. Abstract feelings develop concerning friendly and romantic relationships. While this time can be a chaotic one physically and mentally for young teens, “Early adolescents begin to capitalize on their previous knowledge, skills, and self-regulatory abilities to build toward high level thinking and more coordinated social activities. They show marked improvements in their deductive reasoning, cognitive flexibility, efficiency and capacity for information processing, and expertise in a variety of domains.” (Nagaoka et al., p71)

Teens in Queens is designed to encourage teen engagement despite challenges that can exist in teen development. Speaking from my own teen experience, often presenting myself as disengaged or disinterested was in fact a cover for being immensely engaged, especially in museums. Apathy dictated by peer pressure can be part of a young adolescent’s presentation to the world, but not necessarily an accurate portrait of motivation or interest.

Nina Simon, Executive Director of the Santa Cruz Museum of Art & History and author of *The Participatory Museum*, addressed an audience on teen engagement in museums. She suggests, “Refocusing on ways to invite teens to engage with their own friends around museum content--to create and share photos, stories, and ideas with each other instead of with the wider world of the institution” (2010).

Developing the curriculum for *Teens in Queens*, specific intentions were set to make peer bonding possible and opportunities for long-lasting friendships. Allowing interactions via social media and other digital platforms is likely an integral part of to the success of teen programming in any museum setting. “Teenagers, like all humans,

balance out their self-interest with curiosity about the rest of the world. And while many teens are focused on being where their friends are, listening to what they listen to, liking what they like, they also pursue personal passions.” (Simon, 2010). *Teens in Queens* makes sure to include a passion project for teens to work on independently or within groups to sustain motivation and to take advantage of newly learned skills and experiences.

Not only will teens benefit developmentally, academically and socially from this program, the Queens community will benefit as well. In creating a program that is also a museum partnership, thinking deeply about the best museums for this program was of most importance. Queens is the largest borough, with most of its major institutions not easily accessible by transit. Because of transportation challenges, Queens institutions think deeply about programming for their local community. Each museum chosen for this partnership already has strong community programs and local support. Inviting teens into their museums will help spread information across Queens in support of these institutions, hopefully increasing visitors and interest in further teen programming.

IV. Applications

Teens in Queens is designed as a museum partnership between the New York Hall of Science, the Queens Museum, and the Queens County Farm Museum. Thinking specifically about supporting academic learning while building new skills, *Teens in Queens* works with each museum to learn about different content areas and how to apply new skills in their academic and personal lives.

Each week teens will adhere to a set schedule at various institutions. The New York Hall of Science will serve as a home base museum, where the introductory meeting and end of year exhibition will take place. Students can choose to focus their exhibition project with any of the museum partners, however the culminating event will be held at the New York Hall of Science (NYSCI).

Applicants will be accepted into *Teens in Queens* by submitting a short essay on why this program would be beneficial for them. The only other qualifying factor is that the teen must live or attend school in Queens. This program was created to reflect the diverse population of the borough itself, and pays attention to the needs of the youth community. This program will encourage all students to apply regardless of race, ethnicity, religion, immigration status, sex, disability, or any other factors that could lead to bias or discrimination. Students who are struggling academically or from disadvantaged backgrounds are encouraged to apply. A major belief of this program is that learning new skills in museum settings supports academic learning and a confidence in self.

Each museum has a specific function and offers different content areas: NYSCI will focus on learning new skills using tools in a Maker Space; the Queens Museum will

workshop social justice through contemporary art; and Queens Farm will offer sustainable and accessible agriculture knowledge and skills to underserved communities throughout Queens.

V. Literature Review

The Important Museum

An excerpt from a poem by Billy Collins made me think of the ways adults sometimes perceive teenagers, and how museums can support in this rapidly changing time in an adolescents development.

*When he was your age,
Franz Schubert was doing the dishes for his family,
but that did not keep him from composing two symphonies, four operas and two complete masses as a youngster.
But of course, that was in Austria at the height of Romantic lyricism,
not here in the suburbs of Cleveland.
Frankly, who cares if Annie Oakley was a crack shot at 15
or if Maria Callas debuted as Tosca at 17?
We think you're special just being you —
playing with your food and staring into space.*

(Billy Collins "To My Favorite 17-Year-Old Girl" 2011)

Not only are young adolescents changing physically, but cognitively and emotionally as well. Kurt Lewin (1948), a development theorist categorizes adolescence as a period”

By a relatively rapid change in the structure of the life space, and changes occur in several different domains: cognitive, physical, emotional and interpersonal. The rapidity of the changes in the life space during adolescence may be responsible for the so-called adolescent crisis (Mus 1998, p 132)

The adolescent is experiencing a period in time where they are no longer considered a child; they begin to understand the past, the present, and can look forward to

the future. However, they are not yet an adult, and not seen as responsible enough to live independently. “They are people who belong neither here nor there, standing ‘between’ the groups.” This is a unique moment in the adolescent’s life, they no longer relate to the child group they were most recently part of, and do not relate yet to an adult group. Therefore, adolescents “experience lack of social anchorage except in relationship to his or her peer group. These conflicts in values, attitudes, ideologies result in increased emotional tension” (Mus, p 136).

The educational implications for this stage in one’s life rely on support from their own age group. Adolescents can involve themselves in after-school activities with their peers, or join extracurricular in school. Supporting adolescents with peers of their own age group will help form bonds that can transition into adulthood. Not only should schools embrace adolescents, but cultural institutions must embrace this stage of development as well.

Museums exist for many purposes, and one is to educate the public. They exist for children to learn, play and interact with concepts they might not be exposed to at home. Adults can increase their knowledge or engage in learning something new. For adolescents, I believe that the museum can support the transition from child to adulthood by helping adolescents learn about themselves. Adolescents can explore a museum of any content area and decide what engages them; is it a specific painting, and if so, why does this painting move them? In science museums, an adolescent can discover something about the world they never knew could be possible and concentrate on that subject for higher learning. New discoveries are made every day in museums of all different content

areas, and there is no better time to experience them than in early adolescence. In an essay by David Car (2003) he states:

A human being *becoming* is the critical center of the entire cultural institution-*critical*, because museums and libraries exist to assist changes, passages, and transformations; *critical*, because experiences in history, art, or analysis can induce a turning point in the knowledge that grounds us; and *critical*, because the fate of our question leads us towards differences in how and what we learn.

Cultural institutions must support visitors of all ages to ask questions. Questions that further their knowledge, excite them, inspire, and questions that might not have an answer. Museums exist not only to aid in public knowledge but also to inspire creative inquiry about the world around us. Adolescents can benefit from asking questions in museums and seeking to find the answer within themselves will not only help their cognition, but will aid in interpersonal development and social bonding.

The Effective Museum

In order for museums to participate in active learning experiences for its youth, it must engage itself in youth programming. Many museums have teen programs, but what makes for an effective one? According to a research guide presented by The Institute of Museum and Library Services', "The most effective youth programs are guided by an approach called positive youth development, a framework based on the belief that, given

guidance and support from caring adults, all youth can make positive contributions” (Steele, K. 2013). An integral part of *Teens in Queens* is listening to what teens want out of the program. Forming group learning experiences is important to the structure of the program, and will allow for a more comfortable environment amongst the participants. In 2015 The National Research Council in Washington DC compiled a report in collaboration with the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The study researched where and how students learn STEM and produced a criteria for STEM learning opportunities in out-of-school settings. A key finding of their study was the importance of social support:

Research shows that socially supportive contexts are linked to such outcomes as increased pro-social behavior and school achievement. Thus, thoughtfully designed supportive learning communities may be key to young people’s STEM learning in out-of-school programs, and they may be particularly important for broadening participation in STEM for young people from historically underrepresented communities. (p 19).

Teens in Queens values group learning environments, however the program also acknowledges the importance of teens taking ownership and having responsibility for their own projects. This program encourages its youth members to be active decision teens and part of the program process. *Teens in Queens* asks its participants to be active members of the museum space, and to feel comfortable with expressing their ideas and inquiries. A program that has a similar theme to *Teens in Queens* was inspired by John

Dewey's theory of education; that students learn best through hands-on experience, at Memphis Brooks Museum of Art. Their teen program:

“Encouraged [teens] to express themselves through dialogue with each other, and to participate in the curriculum development of the program. The purpose was for the teens to take charge of their own learning and to perceive the museum as a place they were welcome and respected as creative individuals with valuable contributions” (Hornby and Bozick. 2016, p152).

Teens were responsible for their own learning, expressing their interests in a specific content area, then working with their chosen department on various projects. A culminating event at the museum, artPOPcultureFEST coincided with the opening day of the artPOPculture exhibition at the museum. “Teens were responsible for developing and testing the activities, selecting the food menu, maintaining a project budget, marketing the event, creating a music playlist, and facilitating the activities during the event” (p154).

This program was evaluated by asking teen participants and their parents a series of questions about their experiences at the end of the program. All of the teens along with their parents gave positive remarks about their experience and would come back again if the program were offered in the next year. A common thread of answers were about making connections with peers, “One participant described herself as ‘antisocial’,

however pointed out the teen program allowed her to meet and communicate with other teens who enjoy art” (p. 156).

Another teen program dedicated to providing museum learning opportunities to underserved communities is the New Bedford Whaling Museum’s High School Apprenticeship Program. The museum developed a three year program as a direct response to low high school graduation rates in the underserved neighborhood of New Bedford, MA. “Throughout their three years at the museum, the 18 high school apprentices develop organizational, team-building, public speaking and problem-solving skills through project-based learning activities” (Rose, p 286). After evaluating their program they found an optimistic result; “100% of our participants have graduated from high school and were accepted into post-secondary programs, compared to the New Bedford Public School District’s 53.5% graduation rate when the program started in 2010.” (p. 287).

Teens in Queens aims its effectiveness at the engagement of its adolescents by allowing them to be part of the decision making process of the program itself; supporting peer to peer communication; while connecting the curriculum with school academics and supporting the constant process of learning through inquiry. Creating a program unique to the development of teens is an important component that will enhance the effectiveness of the program.

The Community Museum

The museums chosen for this program are three of the larger museums in Queens, New York. The New York Hall of Science and the Queens Museum are both located in

Corona, Queens on opposite sides of Flushing Meadows-Corona Park. Both museums were created for the World's Fair in 1964. Since their openings, both museums have transformed from themed attractions to valued cultural institutions.

The New York Hall of Science prides itself in its work within the Corona Community. The museum has a long-standing partnership with a local elementary school, and they have worked together developing a program called Science Ambassadors. Families from the neighborhood are given a free membership and are able to participate in free maker and design projects offered by the museum after school. Not only does the museum connect with local families with young children, but they have an outstanding teen program as well called the Science Career Ladder, Explainer Program. High school and college students apply into the program and if chosen, they become a paid “explainer” of the museum. While in the program, the students are trained to interact with hands-on exhibits, perform science demonstrations, and help facilitate educational programs and workshops.

“Participants acquire communication skills, knowledge of science and the scientific process, and gain experience in teaching and communicating science. While working at NYSCI, participants also benefit from career workshops, networking opportunities, exposure to STEM careers, and opportunities for growth” (Maker Education Initiative Annual Report, 2016).

The Queens Museum has a teen program named *Queens Teens*, which invites teens from the community in to learn more about how contemporary art and social justice intersect. One of the program's goals is to inspire teens to promote positive social change through art within the Queens community and beyond. If the students excel during the

program they are offered the opportunity to volunteer within different departments at the museum to gain more knowledge of how museum departments run. Students are offered school credit if they continue at the museum after the program is over.

The Queens County Farm Museum offers a small teen program called *Teen Thursdays*, where teens from their partner middle school IS 295, are able to engage in learning about and participate in the working farm. Their eight week program focuses on getting to know the Queens Farm by hands-on interactions with the land, colonial buildings and artifacts. Teens are given the opportunity to learn about sustainable practices and participate in the growing of organic food.

Offering a museum partnership between these three institutions will support connecting different content areas and asks students to make independent decisions about where they would like to focus their interests. *Teens in Queens* offers these different museums that all have STEAM content. STEAM learning has become a popular focused area of content in schools in the past decade. According to The National Research Council in Washington DC, “Out-of-school STEM programs that situate STEM in relevant settings and contexts treat young people as knowledgeable and capable, thus supporting them intellectually, socially, and emotionally to fully participate, contribute, and develop as members of the STEM learning community” (2015, p21).

Adding the “A” in STEM to represent “Art” has become prominent in recent years, understanding that learning about art is not mutually exclusive to the sciences. STEAM learning is especially important in underserved communities like in Corona, Queens, primarily a Latinx community where 21% of the population lives below the poverty level and 57% of the population has been born outside of the United States. A

survey from 2013 showed that 37% of people said they do not speak English well, or at all (City Data, n.d.). STEAM learning has been shown to benefit academic learning, and not only aids in conceptual development, but language and abstract learning. “Research shows deep links between identity development and learning, illustrates the importance of engaging youths as both leaders and learners, and demonstrates the significance of addressing young people’s agency in their learning” (2015, p22).

In a research essay developed for and conducted at the community-based organization in New York City, “El Centro.,” where their mission is to develop leadership in a context of community development and social justice. Clara Waloff (2013) interviews teens participating in El Centro’s mission to develop leadership roles within primarily Latinx communities:

In their own words, the youth I spoke with described it as participation involving more than “just showing up.” Common elements include participation that: develops voice and identity; allows for development of relationships with peers and adult mentors; provides opportunities for decision-making and problem-solving; and encourages involvement in real-world settings and connection to community.

Museums have a responsibility to their communities, which can be determined differently by each institution. In my opinion, all museums should understand their communities by engaging with its members outside of the museum as well as inside. Museum educators should benefit from the community, learn more about what the community is offering its people and how the museum can partner with those resources.

Paulo Freire's writings speak to an educator's responsibility to the community. He writes that the educator is a politician:

It is absolutely necessary that educators act in a way consistent with their choice-which is political- and furthermore that educators be ever more scientifically competent, which teaches them how important it is to know the concrete world in which their students live, the culture in which their students' language, syntax, semantics, and accent are found in action, in which certain habits, likes, beliefs, fears, desires are formed that are not necessarily easily accepted in the teachers' own worlds (Freire 2005, p129).

While smaller institutions usually are competent in engaging with its community, larger institutions could benefit from the reminder that the museum sits within a community, often a vibrant representation that is not often reflected within the museum's galleries. In order to have programming that is beneficial to the museum, then it must be beneficial for its community.

Creating a museum partnership program will strengthen community involvement. Students will gain the opportunity to travel outside of their local neighborhood with the extension of the Queens County Farm, or depending on where the students live, they might experience these museums and neighborhoods for the first time. The Institute of Museum and Library Services (Steele, K. 2013) are strong supporters of museum partnerships:

Partnerships strengthen a museum's or library's community involvement, enrich its capacity, build an enlightened audience, and signal a commitment to youth to everyone in the community. There are many benefits of collaborating, including reaching more youth by pooling resources; making your project more attractive to funders by involving multiple organizations in a community; and working with other community groups rather than competing with them (p. 19).

Providing opportunities for adolescents in the Queens community will benefit individual participants by allowing a sense of leadership and ownership over ideas, communicating those ideas to peers and museum educators. Supporting these teens in museum spaces will not only benefit the individual, but the community as well by creating a more inclusive environment through STEAM education which will support and hopefully strengthen school academics, leading to engagement in subjects that will carry on to higher learning institutions. Hopefully, the participants in *Teens in Queens* will be thinking about their interests, how to strengthen their academic portfolios, and what their next steps are in their personal and academic lives, all the while playing with their food and staring into space.

VI. Program Schedule

Sessions and Location	Welcome	Guiding Questions
<p>Session 1: Welcome and Introductions</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Introductions <input type="checkbox"/> Ice breakers <input type="checkbox"/> Logistics/ going through the schedule <input type="checkbox"/> Journal Making - See lesson plan 1 <input type="checkbox"/> Next Week: Bring personal object 	<p>What is brainstorming?</p> <p>What do you want to get out of this program?</p>
<p>Session 2: Collaboration and Community</p> <p>Queens Museum</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Personal Object Activity <input type="checkbox"/> What do we know about Queens? <input type="checkbox"/> Panorama Tour <input type="checkbox"/> See Lesson 2- Collaboration Art Activity 	<p>What is social justice and activism?</p> <p>How can art be activist?</p>
<p>Session 3: Sustainable Agriculture</p> <p>Queens County Farm Museum</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Tour of the farm <input type="checkbox"/> See lesson 3- Composting and Seed Bombing- 	<p>How can we use sustainable agriculture in our own lives?</p> <p>How can this farm benefit the larger Queens community?</p> <p>Seed Bombing Activity</p> <p>Compost Campaigns Activity</p>

<p>Session 4: 3D printing</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> 3D printing basics- Movement Activity <input type="checkbox"/> Block Modeling <input type="checkbox"/> See lesson plan 4- What is 3D Printing? 	<p>How can 3D printing help our community?</p> <p>If you could create anything by 3D print, what would you make, why would we need it?</p>
<p>Session 5 3D printing continued</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Tinkercad <input type="checkbox"/> See lesson 5- Intro to Tinkercad 	<p>What is Tinkercad?</p> <p>How can we use Tinkercad for a useful purpose?</p>
<p>Session 6: Circuits</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> What is circuitry? <input type="checkbox"/> See lesson 6- Circuit blocks and paper circuits 	<p>Why should we learn how to use circuits?</p>
<p>Session 7 Working with Bees</p> <p>Queens County Farm</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Importance of bees- See lesson 7- Making beeswax birthday candles 	<p>Why are bees important?</p>
<p>Session 8 Independent Projects</p> <p>Queens Museum</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Project ideas <input type="checkbox"/> Artist in residence tour and talk 	<p>What are your project ideas?</p> <p>What is the purpose of your idea? Who will it benefit? How?</p>
<p>Session 9 High School Portfolio Workshop</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Building a portfolio <input type="checkbox"/> Researching High Schools <input type="checkbox"/> Interview Basics <input type="checkbox"/> Writing an Essay 	<p>What type of school is the right fit for you?</p> <p>Why is it important to think ahead?</p>

<p>Session 10</p> <p>Farmyard in Spring</p> <p>Queens Farm</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Learning about livestock, seasonal farming <input type="checkbox"/> The role of farmers <input type="checkbox"/> Farming in an urban city 	<p>What is the role of a farmer?</p> <p>How can farming support underserved communities?</p>
<p>Session 11</p> <p>Choosing a Museum site</p> <p>Queens Museum</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Understanding how each museum can support your project <input type="checkbox"/> Thinking about a site <input type="checkbox"/> Planning your idea <input type="checkbox"/> Meeting Exhibit Designers 	<p>What tools will you need?</p> <p>What space feels most comfortable?</p> <p>Why is your project important to you?</p> <p>What goes into planning an exhibit?</p>
<p>Session 12</p> <p>Planning</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Planning for site of choice <input type="checkbox"/> Writing down process <input type="checkbox"/> Begin working on first steps <input type="checkbox"/> Discuss Materials for the Arts Trip 	<p>How can museum staff support you and your project?</p> <p>What are your first steps?</p> <p>What will help guide you through each step of your project?</p> <p>What materials will you need?</p>
<p>Session 13</p> <p>Field Trip to Materials for the Arts</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Learn about materials <input type="checkbox"/> Materials for the Arts Mission <input type="checkbox"/> Tour of the space 	<p>What materials can you use for your project?</p>

<p>Session 14</p> <p>Discussing projects</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Conferencing in with each participant on their project idea <input type="checkbox"/> Finalizing ideas <input type="checkbox"/> Approving site 	<p>What are your plans for your project?</p> <p>How will you support your vision?</p>
<p>Session 15</p> <p>Working on projects at chosen site</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Begin work on projects <input type="checkbox"/> Checking in with educators at chosen site <input type="checkbox"/> Checking in with peers 	<p>What are your goals for your project?</p> <p>Who or what will your project benefit?</p> <p>What is your confidence level?</p>
<p>Session 16</p> <p>Continue working on projects at chosen site</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Continue working and checking in with peers/educators 	<p>Support from supervisors as needed</p>
<p>Session 17</p> <p>Continuing projects at chosen site</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Continue working and checking in with peers/educators 	<p>Support from supervisors as needed</p>
<p>Session 18</p> <p>Finishing projects at chosen site</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Finishing Touches <input type="checkbox"/> Preparing presentations 	<p>Support from supervisors as needed</p>
<p>Session 19</p> <p>Review- what have we learned?</p> <p>NYSCI</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Preparing presentations <input type="checkbox"/> Making displays <input type="checkbox"/> Practice exhibiting to peers 	<p>Why did you decided to make this?</p> <p>Who or what needs this?</p> <p>Will it benefit our community</p>

Session 20 Prototyping Exhibition- NYSCI	<input type="checkbox"/> Exhibiting to museum visitors, educators, parents, friends, peers.	If you want to move forward with your prototype, what will you need?
---	---	--

VII. Lesson Plans

Lesson 1: Journal Making (Appendix A)

This lesson was inspired by an existing lesson at the New York Hall of Science for its Make Academy Program. The following lesson has been revised with the permission of the New York Hall of Science to accomplish the needs of the *Teens in Queens* program.

New York Blueprint for Teaching and Learning in Visual Arts standards:

1. Community and Cultural Resources: Learning in a museum environment
2. Making Connections Through Visual Arts: Using tools to create a journal that visually represents each student and allows for further expression.
3. Developing Visual Arts Literacy: Students will make connections in their journals each week and discuss what they have learned all all three institutions.

New York State Common Core Standards:

[11-12.WHST.10](#) Writing HS/S/T Range of Writing: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

[11-12.WHST.2](#) Writing HS/S/T Text Types and Purposes: Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

[11-12.WHST.2.a](#) Writing HS/S/T Text Types and Purposes: Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

Overview:

Making a journal is an appropriate introductory activity because it provides plenty of opportunities for success and is open enough to allow for plenty of variation. Students will use a variety of tools and materials to make their journals, then spend some time personalizing it with decorative flair, buttons, stickers and whatever else they come up with. Students will use their journal each week at the end of the day to write down what they have learned and any ideas they might have for their project.

Materials:

1 Sheet of cardstock for cover, various colors

10 sheets of paper- can use plain, graph, or both

Hammer

Large Nail

Foam Block

Binder Clips

Embroidery Needle and Floss

Scissors

Personalization Materials (optional): washi tape, markers, crayons, buttons, duct tape, other various decorating materials.

Introduction/Discussion:

Begin the activity by asking which students use a notebook or a journal, and what they use it for. Typical examples could be about school notes, and diaries and through discussion the group should come to the idea that notebooks and journals are places where people can record information they don't want to forget and keep records of ideas to go back to later. Have samples of journals to use as a model in order for students to visualize what a past journal looked like. Explain that the students are going to make journals of their own, to be personalized and used to record any thoughts, ideas, feelings and drawings throughout the program.

Exploration: Properties of Materials

Begin by showing the students a sample notebook, and pass around a few examples for them to look at and explore. What's it made of? How was it made? What tools do you think you would need to make this?

Use the large scale model of the needle and thread to demonstrate how to thread a needle. Show them how to sew the binding of the large scale book (cardboard mock up). Another approach is to ask for two student volunteers and have one thread the large scale needle and the other one can try sewing the large scale book made out of cardboard.

Show students the hammer. What is a hammer used for? Why would someone need a hammer to make a journal? The group will use a hammer to drive nails through

the binding of the journal so it is easier to sew the binding. Explain that hammers are typically used to drive nails into wood, but the students will use them to hammer through paper into foam blocks.

Possible questions to ask the students: What material do you think is harder, wood or foam? Which material would require more force to hammer into it? For this project the students will tap gently on the nail to punch the holes through the paper. Once an educator has explained how the tools are used, begin the process of the build. From the discussion the group should have revealed all the materials necessary to make the journals.

Procedure:

Go over the steps below verbally with the students, introducing each step and how it leads to the next. Then have them gather all their materials and start making!

1. Start by folding just the card stock cover in half by lining up the far corners. Once folded slide the craft stick down the fold to make sure it is a straight edge.
2. Fold all 10 sheets of paper in half in the same manner. You can do it individually but we would suggest doing them all together.
3. Open the cover and insert 10 sheets of paper. Use a binder clip to secure the cover to the inserted pages. Typically one on the top and one on the bottom works well.
4. When the pages are all clipped up, lay the booklet open (paper side up) on the foam block, lining up the crease from the folds with the foam.

5. Start the first hole at the top of the binding in the crease. Hammer the nail all the way down, through all of the pages and the backing. It's alright if it goes into the foam. That's what it's there for. Pull the nail out and move it down the seam about a half an inch and add another hole. Continue in this manner until the bottom of the page has been reached.

Note that the more holes the stronger the binding but the longer it will take to sew.

6. Time to cut the thread and thread the needle. The appropriate length of thread always turns out to be about the length of your outstretched arms. So grab the end of the thread, and unroll slowly with the other hand until your arms are stretched wide, snip it off and begin to thread the needle. Embroidery needles have a slightly larger eye and are therefore a bit easier to thread, however a needle threader is always helpful. No matter how this task is accomplished, once the thread is through the eye, pull it until it's doubled and then knot the two ends together.
7. Once the needle is threaded and the knot is tied, begin sewing the binding. Suggest starting with the knot on the outside (meaning the cardstock side) and go up through to the paper. Make sure the students are going through **all** the layers here from the backing all the way up through all ten sheets and pull until the knot reaches the backing. Then go back down through the next hole in the paper and pull until taught again. Continue in this fashion until the opposite end of the book has been reached. Then sew back the other direction towards the starting point. This time, sew in and out of every opposite hole thereby closing up the white space gaps between the binding thread. When students have reached the top

where they started, tie a knot and cut the remainder of the thread off, or leave it, sometimes a longer thread is nice for a bookmark.

8. Take binder clips off and personalization can begin.

Helpful Hint: Set up materials in designated place allowing them to select their materials and return to their table to work on their project. This a fairly materials intensive activity, and it is helpful to have a clear workspace free of clutter or excess materials.

Reflection Prompts:

Now that the students have journals they can write their first reflections. Try and keep journal prompts fairly open ended but always encourage students to write what they made and how they made it. They can write, diagram or do some combination of the two. Explain that diagramming and journaling help us to make changes in the future, and remind us of the process. After students have journaled, invite them to share their responses and processes from the day in a group discussion and reflection.

What did you make?

How did you make it?

What tools did you use? How did you use them? How might you use them in the future?

What materials did you use?

What might you change in the future?

What was challenging?

What was easy?

Did anything surprise you?

Lesson 2: Queens Museum- Collaborative Art Making and Personal Object

Activity

New York Blueprint for Teaching and Learning in Visual Arts standards:

1. Developing Visual Arts Literacy: Students will engage in close looking activities and record observations and form questions.
2. Problem Solving: In small groups students discuss how they resolved the challenges of a particular design problem.

New York State Common Core Standards:

1. [SL.11-12.1.b](#) Speaking & Listening Comprehension and Collaboration: Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed.
2. [SL.11-12.1.e](#) Speaking and Listening Standards Comprehension and Collaboration: Seek to understand other perspectives and cultures and communicate effectively with audiences or individuals from varied backgrounds.
3. [SL.2.1.a](#) Speaking & Listening Comprehension and Collaboration: Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).

Overview:

As the teens continue to get to know each other, this personal object activity is used to be an ice breaker into the lives and personalities of teens and educators. This is a close looking activity and will hopefully accomplish the goals of people's assumptions about others around them and will make the group stronger as they learn more about one another.

Materials:

Students were asked last week to bring something personal (but not irreplaceable) with them this week to share with the group.

Personal Object Activity:

1. Ask the teens to carefully meet an educator outside the room to hand in their personal object. They must be discreet and make sure they cover up their object as they leave the room to give it to the educator.
2. Once all students have handed their objects in, the educator will come in the room and place the objects randomly on the table.
3. Turn to a neighbor to discuss whose objects they think belong to which person in the group.
4. Go around the room and whoever thinks they know which objects belong to an owner they will make the assumption and be told if it was correct or not.
5. As the group finds out the owners of the objects, the owner will discuss the object, why they brought it and what it means to them.

Collaborative Art Straw Activity

Overview:

This is a team building activity that helps teens understand and value the process of communication and cooperation. The rules focus on the challenges of communication, and how to problem solve and collaborate to create a finished product.

Materials:

Boxes of plastic straws, one box per group.

Tape

Key Vocab:

Teamwork

Assumptions

Collaborative

Connecting

Supportive

Structure

Procedure:

1. Split the teens into groups of 3 or 4 depending how many there are.
2. Give them the task of creating the tallest, strongest structure only using straws and tape without speaking verbally.
3. Students may not use any other material. The straws may be bent but not cut or manipulated in any other way.
4. Students may not verbally express their actions, they must find alternative ways to communicate and work together.
5. The structure that is the tallest and most stable will be the winner.

Reflection:

Students will discuss the process of collaboration without speaking. How was the process? Easy or difficult? What challenges other than communication did you struggle with? How did the team work together? How did the team communicate when building the structure?

Lesson 3: Composting and Seed Bombing (Appendix B)

This lesson was inspired by an existing lesson at the Queens County Farm Museum for its Teen Thursday Program. The following lesson has been revised with the permission of the Queens County Farm Museum to accomplish the needs of the *Teens in Queens* program.

New York Blueprint for Teaching and Learning in Visual Arts standards:

1. Developing Arts Literacy- In small groups students discuss how they resolved the challenges of a particular design problem.
2. Artmaking- relate: careful inking, and planning and execution of an engraving, stencil print, collage, or monoprint. Knowledge of signing and numbering of an edition a personal view or unique perspective unity. Composition explorations with textured materials, exploration with visual texture.

New York State Common Core Standards:

1. [9-10.RST.3](#) Reading Science/Technical Key Ideas and Details Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
2. [9-10.RST.4](#) Reading Science/Technical Craft and Structure Determine the meaning of symbols, key terms, and other domain-specific words and phrases as

they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

3. [9-10.RST.5](#) Reading Science/Technical Craft and Structure Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., compost, environment, agriculture, energy).

Overview:

Through a series of exploratory activities, students engage with the compost exhibit and demonstration site to learn the basic science of compost. Farm educators teach how we make and use compost at Queens Farm and why it's important to divert food waste from landfills. Students take home a resource kit, to begin composting in school or home.

Materials:

3 yellow wheelbarrows and wooden screen sifters, gloves, trowels, thermometers, magnifiers, shovels, pencils, markers

Seed Bombs: clay, water, seeds, egg cartons, compost in 3 Tubtrugs

Campaigns for compost: scrap paper, pens and markers

Introductory discussion:

Begin by asking students: What have you thrown away today? Have you recycled anything today? These are waste materials: any items we no longer find useful and we want to throw away. How do we dispose of waste? By reusing, recycling, composting, burning, and putting it in a landfill. All of these have impacts on the environment

Most of NYC's waste is transported by barge or truck to landfills or incinerators outside of the city. This system requires a lot of fuel- which is a nonrenewable resource. How can we reduce waste? Reduce waste before it happens: consume less, reuse what you can, recycle as much as possible. Today we're going to talk about a particular type of recycling, the recycling of organic materials, or composting!

What does the term "organic materials" mean? Anything that is a living thing or was once alive. Humans are made of organic material. What else is made of organic material? Plants, animals, people etc. What is not organic material? Metal, glass, plastic rocks, etc. Only organic items should be in compost.

What is compost? Show an example of finished compost. Let the students touch it, smell it, etc. Ask the students to come up with their own definition of compost.

Farm Definition: compost is a dark brown, earthy-smelling, and nutrient-rich material. It is a fertilizer and key component of healthy soil, which is essential to farming and the planet.

Ask the group to turn and talk to a neighbor about soil. What is soil? Allowing students to offer various responses is important, but as an educator guiding the students is also a valued skill. Convey that the upper layer of earth in which plants grow, soil is a

black or dark brown material typically consisting of a mixture of organic remains, clay, and rock particles.

Composting is the speeding up of the way nature recycles organic materials. In nature, when leaves or other organic materials fall to the forest floor, they slowly break down and are consumed by a range of decomposers. It is then worked back into the soil and its nutrients are used by other organisms. By composting home, at school, or on a farm, people are able to control the types of materials, moisture, heat, and air to speed up this process. The final product can also be worked back into the soil to give necessary nutrients to vegetables and plants.

Ask students: what belongs in the compost pile? What should be recycled? What is trash? Why do we make compost? Why is it valuable? If these organic materials are going to a landfill now, won't they just decompose and turn into compost there?

Unfortunately, this is not the case. When they are layered and compacted with other trash, they lack the oxygen needed to decompose. Instead of creating a healthy amendment for soil, the organic material mixes with other materials in the landfill and make toxic liquids and gases that could pollute the surrounding environment. By composting humans can reduce the amount of waste going to landfills, reduce the amount of fuel consumed in transporting the waste, and make a soil amendment to grow strong plants using these nutrients that would otherwise be wasted.

The next step is to engage in activities that communicate the ways in which students can compost in school or at home.

Exploration Activity-Windrows

Lead group over to the ‘windrow’ sign. Have one student read aloud. Next, lead the students over to the sifting station. Explain the purpose of sifting compost, the tools to use, and the process of sifting compost.

Overview:

Before applying compost to growing fields, farmers use screens and sifters to aerate finished compost. This ensures the compost is free of clumps, rocks and loose enough to spread evenly into the soil. Ask the students: Have you ever seen a weirdly shaped carrot? That’s a result of lumpy/rocky soil. At the sifting station, students will have the opportunity to practice sifting finished compost.

Tools:

Wheelbarrow (one per 3 students)

Screen (one per wheelbarrow)

Garden gloves (for each student)

Garden spade (shovel)

Procedure:

1. Place screen on top of wheelbarrow.
2. Scoop three shovelfuls of compost from the 'finished' pile onto the screen.
3. Using gloved hands, move compost around on the screen until smaller particles fall through and the only objects left are too big to fit through the screen.
4. After, have students explore the windrows on their own. Hand out magnifying glasses and trowels.
5. Have the students begin diagramming the space and writing notes on materials and/organisms they found and where.

Seed Bomb Activity

Overview:

What should people do with excess compost?

Mix it in with the soil on the fields to add vitamins and nutrients back in. The plants will grow nice and strong and people don't have to buy fertilizers whether they be organic or chemical. Compost can be free!

The group will take compost home and start a little garden where they feel the plants can grow. Suggest to the students that they can advocate for a garden at their school if they do not have a yard or place close to their home.

Students will make something called a seed bomb. Seed bombing was invented as part of a movement to make a city greener. People would make seed bombs to start gardens in places and spaces that are not easy to get to. This type of gardening allows people to easily spread plant seeds around. People in this city-greening group would

throw seed bombs into abandoned lots, on sidewalks, in ditches, etc. This seed bomb is little package is made of clay, compost, and wildflower seeds. Seed bombs can usually grow in almost anywhere quite easily because the compost and clay provide nutrients and protection for a seed to grow.

Students can plant them carefully in gardens, throw it anywhere in their backyards, put them into containers of soil, or throw it into an abandoned lot. Although it is easy for seed bombs to grow, they still need to be watered, by rain or by people.

Guiding Questions:

What do your seeds look like?

What are some things these seeds need to grow?

What do you think they'll grow into?

Why do we use clay and compost for the seed bombs?

-compost/soil provide nutrients for seeds to grow and are anchors for seeds' roots to grab on.

-clay protects the seed, holds the seed and soil together, and provide extra support for seeds' roots.

Procedure for making a seed bomb:

1. Roll a ball of clay
2. Flatten it with your palms
3. Add a pinch of compost on the flattened clay
4. Sprinkle with water (too much water can drown the seed!)

5. Add a tinier pinch of seeds
6. Roll the ball of clay, compost, & seed together

Helpful Hint: Traditional seed bombs are rolled into a spherical shape, but you can use your imagination and create other shapes.

Campaigning for Compost Activity

1. Break students into smaller groups of 4-6 people each.
2. Briefly review composting, its importance, and how it can benefit communities in Queens, New York.
3. Tell the students to think about convincing a family member or friend why and how they should compost.
4. Use markers, crayons, pens, or any other materials provided to create a campaign for compost.

Reflection Prompts:

Students will write in their journals and discuss with peers:

Where will you plant your seed bomb? How can seed bombing aid in community building? Think about asking an authority in your school or community to hang your compost campaigns, or think about starting or joining a compost club or where to plant the seed bombs.

Lesson 4: What is 3D Printing? (Appendix C)

This lesson was inspired by an existing lesson at the New York Hall of Science for its Make Academy Program. The following lesson has been revised with the permission of the New York Hall of Science to accomplish the needs of the *Teens in Queens* program.

New York State Common Core Standards:

1. [9-10.RST.3](#) Reading Science/Technical Key Ideas and Details Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
2. [9-10.RST.4](#) Reading Science/Technical Craft and Structure Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
3. [9-10.RST.7](#) Reading Science/Technical Integration of Knowledge and Ideas Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
4. [6.RP.3.d](#) Ratios And Proportional Relationships Understand Ratio Concepts And Use Ratio Reasoning To Solve Problems. Use ratio reasoning to convert

measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

5. [L.2.5](#) Language Vocabulary Acquisition and Use Demonstrate understanding of figurative language, word relationships and nuances in word meanings.
6. [L.2.5.a](#) Language Vocabulary Acquisition and Use Identify real-life connections between words and their use.

Overview:

This is the first time the teens will officially be actively engaging in learning about the 3D printer. This lesson is structured to help teens understand what 3D means and how they can create 3D objects using various materials. There will be three different activities in order to help engage and understand the possibilities of the 3D printer. The goals of these activities are to explore how 3D printing works, what the parts of the 3D printer are, and how to create designs using specific tools. Teens will engage in a layering activity, kinesthetic activity, and hot glue activity to help understand the most successful ways to create an object by thinking about surface area, overhang and orientation. Teens will think about how using layers of the same material can help create a 3D object.

Materials (Per student):

Activity 1: Layering shapes with foam

6 Foam Squares

1 Scissor

Activity 2: Kinesthetic Shapes

The only materials used will be their bodies!

Activity 3: Hot Glue Creations

A piece of wax paper

Duct tape- to secure wax paper on table

Pencil

Hot glue guns

Helpful Hint: While the kinesthetic activity is going on, have someone set up the hot glue guns on two different tables. Use the 4 prong extension cable to set up 4 hot glue guns per table. May need more depending on the size of the group.

Key Vocabulary:

2D / 3D

3D Printer

Extrude

Layer

Printer Bed

Surface Area

Overhang

Orientation

Introduction/Discussion:

Have a 3D printer running and ask the teens to explore the room with their eyes, what tools do they see? When looking at the 3D printer, have them observe and react to how the printer moves, what do they notice? Some words they might say: pulley, motor.

Introduce the word *extrude*. What other words start with *ex*? What could *extrude* mean? Hopefully the teens will observe that the printer extrudes the plastic, heats it up so the plastic melts in order to take shape, then cools it down on the printer bed, finally forming a layered solid object. Ask the teens what they think would happen if the plastic would come out all at once quickly? They should understand that it would not be able to take shape.

What is a layer? The first thing the machine does it create a base layer. Then it will build up in layers to create the design in the computer. Each time it lays down a new layer, that layer will cool down and harden. The layering process will continue until the shape is complete. Is something that is made of layers weaker or stronger than one solid object? Have ready a layered 3D printed object, and a solid object so the teens can compare. 3D printed objects are weaker due to the layers, which is why we have to think about how we design the object to make it as strong as possible.

Procedure:

First Activity: Layering shapes with foam

1. Picture a shape that you can create in layers. Use an example a teen offers, ex:
Sphere.
2. How would someone begin to create a sphere? A student might start with a small dot, then build up with larger pieces. Alternatively, a student could start with a very large circle then build up using smaller pieces.
3. The constraints of this activity is that each teen is only allowed 6 pieces of foam, so they have to think about how to use the materials effectively to create what they want.
4. Pass around examples of layered shapes teens have created in the past.
5. Cut out shapes, and stick them to each other by peeling off the backs of the foam.
6. Once they are finished, choose an example of one that has a strong surface area and little overhang, if possible and one example with an excess of overhang and small surface area.

Helpful Hint: Make sure that we are acknowledging the teen's hard work, and all examples are valid, however we want to make sure everyone understands how to most effectively create a design for the 3D printer. At the end of the day, all teens should have gained an understanding of surface area, overhang and orientation that work for the tool they will be using.

Reflection Discussion for First Activity

Surface Area- Area of the base of the object. The amount of space that the bottom of the model is touching the bed of the printer.

What will happen if the base of the object is too small? - The object won't sustain the balance if the surface area is too small and will collapse.

Overhang

If we think about the printer moving in layers, we have to think about overhang. Imagine a balcony or fire escape on a building. The fire escape hangs outside of the building, which is overhang. If the object has too much overhang, what happens to the area underneath? If there is nothing under to support the overhang, that area will collapse. Think of creating a shape with as little overhang as possible.

Orientation

Orientation is the direction something is facing. Have the teens hold up their created layered objects. Have them turn it 360 degrees, then 90 degrees. Have them move it upside down, or on its side. Ask them the differences between the rotations. What would be an ideal orientation for the designs?

Second Activity: Kinesthetic 3D Shapes

Procedure:

1. In order to reinforce the vocabulary words, have all of the teens go outside into the sandpit.
2. Ask them to position themselves into any shape with their bodies.
3. Once they position themselves, tell them “Ok, see ya in 2 hours!” Begin to walk away.
4. Ask them who would feel comfortable being left for 2 hours in their shape?
5. Their reactions will help them better understand these vocab words.
6. The teens laying down should feel the most comfortable because they have a large surface area with little to no overhang.
7. Ask them to stand in a position with strong surface area and no overhang.
8. Now ask them to stand in a position with little surface area and a lot of overhang.
9. Using that example, are there any students who could turn their orientation to better support themselves?

An example from a past group: A student was in a backbend. He was asked if he could change his orientation to have more of a surface area. He understood that he could flip to his stomach and lay with his legs and arms up. Flipping his orientation created the same shape, but in a different position to better support his design.

This activity will help the teens understand how important surface area, overhang and orientation are to their designs. Once everyone has demonstrated during the kinesthetic activity, have the teens return back to their rooms where hot glue guns will be ready to create their next and final activity.

Third Activity: Hot Glue Gun 3D Shapes

Overview:

Create a 3D shape by layering hot glue.

Procedure:

1. Draw any desired shape on wax paper.
2. Once the students have penciled shapes on the wax paper, begin hot gluing the frame of the shape.
3. Once the base layer has dried, begin layering the shape with more glue, allowing each layer to dry a little before moving on.
4. The end result will be a 3D shape that the students can pull off the wax paper.

Reflection Prompts:

What tools did we use today?

What did we learn?

What are the characteristics of a successful 3D print?

Lesson 5: Intro to Tinkercad (Appendix D)

This lesson was inspired by an existing lesson at the New York Hall of Science for its Make Academy Program. The following lesson has been revised with the permission of the New York Hall of Science to accomplish the needs of the *Teens in Queens* program.

New York Blueprint for Teaching and Learning in Visual Arts standards:

1. Art Making- 3D Design: Create a design that demonstrates: unity through the use of color, line, shape, and texture attention to balance. Emphasis, and proportion the integration of color, line, and shape to express a clear message. Inventive integration of text where applicable.

New York Common Core Standards:

1. [L.2.5](#) Language Vocabulary Acquisition and Use Demonstrate understanding of figurative language, word relationships and nuances in word meanings.
2. [L.2.5.a](#) Language Vocabulary Acquisition and Use Identify real-life connections between words and their use (e.g., describe foods that are spicy or juicy).
3. [L.3.4.b](#) Determine the meaning of the new word formed when a known affix is added to a known word (e.g., overhang, surface area, orientation, extrude).
4. [9-10.RST.7](#) Reading Science/Technical Integration of Knowledge and Ideas Translate quantitative or technical information expressed in words in a text into

visual form (e.g., cube, sphere) and translate information expressed visually or mathematically into words.

Overview:

Makers will be introduced to Tinkercad, an online 3D CAD design tool, which can create a model to be 3D-printed. Students will have the opportunity to free-explore Tinkercad, and then be presented with a design challenge: to create a name tag only using simple polygons.

Materials:

Assigned laptop, with username and password, per student

Key Vocabulary:

3D printer

Overhang

Surface Area

Orientation

Introduction and Discussion:

Reflect on lesson from last week:

- What did we learn about and make last week?
- How does a 3D-printer work? How does it print its objects?
- What are the three things that we need to remember about 3-D printing?

Overhang

- What does overhang mean?
- How will it affect how your object is printed? Is it best to print an object with little or lot of overhang?

Surface area

- Is it better for our objects to be laying down or standing up?

Orientation

- How does the position of our object affect how it is printed?

Using what the students already know about 3D objects, they will use an online tool that can help create 3D designs into physical printed objects. The students will be working with laptops and software tools to explore more about how 3D designs are created.

Introduction to Tinkercad:


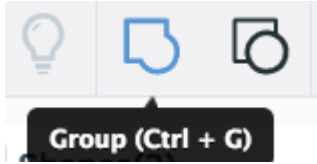
Ask students: What does it mean to tinker? What do you think CAD could mean?

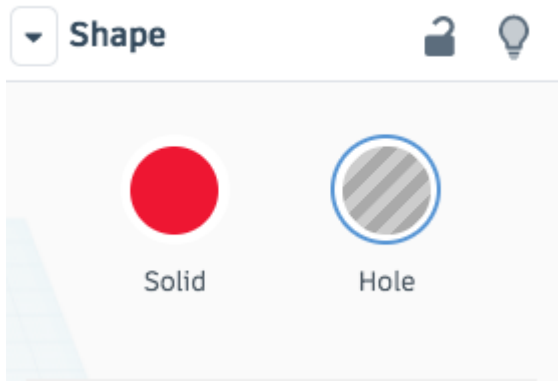
Tinkercad is an online tool that creates designs for a 3D printer.

Procedure:

1. Distribute laptop computers to students. Establish classroom laptop norms (i.e. “What do I want to see on the screen? What are some sites that students should not be on while doing this activity?).
2. Have students sign in to Tinkercad website using pre-assigned usernames and passwords.

3. Once all students are signed in, invite students to freely explore Tinkercad.
4. After some time, gather students together to explore about tools in Tinkercad that everyone should learn:

<p>Perspective</p> <p>Has anyone explored how you can view your design from different points? What tool is that on the site? Why is it important to view our design from different perspectives?</p> <p>Introduce the home button to students, or other related shortcuts (such as holding the CONTROL button and the mouse) to view different perspectives</p>	
<p>Changing Size</p> <p>Has anyone explored or found out how to change the size of the shapes?</p>	
<p>Grouping</p> <p>This tool will group shapes together to</p>	

<p>make a new shape, one large piece, etc.</p> <p>It is imperative that the student's entire piece be grouped before it is 3D-printed.</p>	
<p>Creating a hole</p> <p>This tool can create a hole in shapes to create new shapes. What are some ways that you can use this tool?</p>	 <p>The screenshot shows a software interface with a 'Shape' dropdown menu. Below the menu are two options: 'Solid', represented by a solid red circle, and 'Hole', represented by a blue circle with diagonal hatching. There are also icons for a lock and a lightbulb in the top right corner of the menu area.</p>

Create Your Name Tag:

Challenge students to create a name tag with just shapes. Including a base and a hole if they want a keychain.

Lesson 6: Circuits- Circuit Boards and Paper Circuits (Appendix E)

This lesson was inspired by an existing lesson at the New York Hall of Science for its Make Academy Program. These lessons had supplemental source material taken from The Tinkering Studio's lessons on circuits (see Appendix E). The following lesson has been revised with the permission of the New York Hall of Science to accomplish the needs of the *Teens in Queens* program.

New York Blueprint for Teaching and Learning in Visual Arts standards:

1. Art Making: Create a design that demonstrates: unity through the use of color, line, shape, and texture attention to balance. Emphasis, and proportion the integration of color, line, and shape to express a clear message. Inventive integration of text where applicable.

New York Common Core Standards

1. [11-12.RST.3](#) Reading Science/Technical Key Ideas and Details. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
2. [11-12.RST.4](#) Reading Science/Technical Craft and Structure. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context.

3. [11-12.RST.7](#) Reading Science/Technical Integration of Knowledge and Ideas.
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
4. [11-12.RST.9](#) Reading Science/Technical Integration of Knowledge and Ideas.
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Paper Circuit Activity

Overview:

This activity introduces the teens to basic circuits using paper. Before beginning the activity, circuit boards can be a helpful way to introduce teens who have never used circuits before or might need a refresher. Tinkering in this way is also a fun opportunity for team bonding and conversations.

Introduction/Discussion:

Circuit boards are designed to tinker with electricity using everyday objects and components. Batteries, lights, buzzers, motors, resistors, switches, are but a few of the types of electrical gizmos that can be hooked together with simple alligator clips. By approaching circuit-building with familiar components and direct connections, surprising moments of insights are possible.

A typical exploration begins with the simplest of circuits being completed: a battery makes a light bulb turn on. This deceptively simple connection sparks a delighted and engaged response; for many this is the first time tangibly understanding a concept they might just have read about in a book or heard in science class. Eventually new challenges might emerge: how to introduce a switch into the circuit, or our following activity, creating paper circuits.

Circuit Board Exploration Activity:

The Maker Space already has circuit boards ready for exploration. They will be spread out across two tables for students to explore freely without judgement. Students who have never seen these before might be hesitant to begin, allow yourself as a facilitator to ask questions like:

What do we use batteries for? How do they work? What do you notice about a battery? Have you ever seen alligator clips? What do you think they are used for?

Asking questions about what they notice about the objects in front of them will spark conversation with peers and ultimately lead to new discoveries and hopefully allow them to find out how to turn on the motors by connecting the alligator clips to various boards on the table. Once students are able to turn on their various connections (and it is understandable if some are not able, guide them further until they are able to create the circuit) they can move on to the paper circuit activity. The same concepts that participants learn while tinkering with circuit boards can be helpful in understanding the world around us, from how the light switch work in homes, to how to wire a lamp or repurpose a toy.

Paper Circuit Activity

Copper tape and surface-mount LEDs allow students to turn a fully functional circuit into a light-up greeting card, origami, or three-dimensional pop-up paper sculptures that have working lights in them. Allow teens to be creative with their paper designs, the important aspect of this lesson is that students have working knowledge of basic circuits and why circuitry is important.

Materials

Cardstock- various colors

Copper Tape

LEDs- various colors

Coin cell battery

Key Vocabulary

Circuit

Copper Tape

Conductive

LED

Positive/Negative

Motor

Alligator Clips

Introduction/Discussion:

To start, the educator may want to show a few different examples to the students and examine the components together. The next challenge the educator can help a student start with is getting a single LED to turn on. This allows the student to practice basic techniques like folding or curving copper tape and exploring LED polarity.

Students can draw their designs and circuit pathways with pencils, review their plans together and make adjustments before laying down the tape and LEDs. You can also ask what the student is thinking about making next or what other ideas she has so that when she finishes the simple circuit, she's ready to utilize those skills to make something more personalized or complicated.

Procedure:

1. Fold over one corner of the paper and trace the battery on either side of the fold.
2. Try taping down two strips of copper tape with each piece starting on one of the circles and ending about 1 mm apart.
3. Place a LED in the gap.
4. Fold the battery in the tab created earlier and see what happens. Does the light turn on? If not, try flipping the battery or gently pushing down on the light.

Helpful Hint: Look closely at the LED. You'll notice one wire is longer than the other.

These wires indicate the positive (longer) and negative (shorter) side of the LED. Being able to tell the positive and negative sides will tell you which wire to bend on your battery.

After students understand how to turn on their LED using the copper wire and coin battery, they can start creating their paper circuits! If students are mastering one circuit, challenge them to make two or more. Add as many lights as they can.

Reflection:

What worked for you? What didn't?

What kinds of circuits do we have in our own homes? How do they work?

Lesson 7: What's the Buzz? Queens Farm Honeybees

New York Blueprint for Teaching and Learning in Visual Arts standards:

2. Making Connections Through Visual Art: Recognizing the societal, cultural and historical significance of art; connecting art through other disciplines.
3. Observing and Interpreting the World

New York Common Core Standards

[9-10.RST.3](#) Reading Science/Technical Key Ideas and Details. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions.

Objective:

Students are introduced to the life and behavior of honeybees and learn how bees pollinate many of crops we eat every day. Honeybees are fundamental to our food system. Through an indoor presentation students will be introduced to the life and behavior of honeybees and learn how bees pollinate many of crops we eat every day. Students learn about added-value products through a candle-making activity and taking home an edible honey stick. This program is complemented by a tour of our working farm with specific observation time spent in our apiary.

Introduction/Discussion:

Ranging from a discussion of bee colonies, sustainability, and honey, the Queens County Farm works with beekeepers, environmentalists, gardeners, farmers, urban planners and others interested in the natural history of honey bees and how humans have affected their environment. Bees can be the richest of guides to the most personal understandings about who we are and the consequences of the choices we make in inhabiting the environment around us. Students will watch a short video about bees, and listen to a beekeeper and gardener about the work of bees and human interference.

Students will be asked to brainstorm in groups the following:

How have humans disturbed the population of bees? What do you think the consequences of those actions are? What are some ways in which we can brainstorm solutions to our current problems?

Students will take a tour of the bees at the farm and listen to beekeepers and farmers about the practice of harvesting honey. Students will engage in conversations with the educators at the farm about ways in which we can help the ecosystem bees locally.

Materials for Birthday Candle Activity (per student):

Glass measuring cup

Pan filled with water

Wax

5 Wicks

Hot plate

Procedure:

1. Using a kitchen scale, measure 12 oz. of beeswax in a glass measuring cup.
2. Place this measuring cup into a pan filled with a few inches of water.
3. Melt beeswax on the hotplate over medium heat. (Do not heat the beeswax over high heat or it could ignite.)
4. While the wax is melting, tie each wick to the middle of a pencil. The area that is tied will be the wick that sticks out of the candle.
5. Once the wax has melted, the students are ready to start dipping the wicks for the candles.
6. Dip wicks into the melted wax a few times to create a base layer.
7. Let the wax dry and harden just a bit between dips. The longer the wait time, the better the next layer will coat the candle.
8. Hang tied candles over a can to fully harden.

The wax naturally drips to the base of each candle, creating a long drip that the students will cut off, just to the base of the wick, once the candles are fully hardened.

Use the warmth of your fingers to gently smooth the base of each candle. Trim the wick to a desired length and marvel at your candle!

Reflection:

Students will be asked to write in their journal why bees are important to our ecosystem and crops. How are bees affected by pollution and our infrastructure? What are some possible ways we can help the bees locally?

VIII. Methods of Evaluation

Evaluating *Teens in Queens* will be based mostly on allowing the teen participants to feel comfortable talking about their experiences and how educators can make them better. There are many methods of evaluation that will be conducted, from taking notes reflecting on how the day went to more formal qualitative and quantitative data research, *Teens in Queens* aims to evaluate its program while it is running and making changes based on the suggestions from its participants.

Teens in Queens is interested in researching how this program impacts formal learning for its participants through informal learning institutions. Judy Diamond, Michael Horn and David Uttal discuss the impacts of informal learning in their book, *Practical Evaluation Guide*. “Bridging the gap between formal and informal education can increase student motivation for learning, expand student conceptions of learning and knowledge, and help students develop new skills and abilities” (2016, p13). This research can be completed over time, as this program is meant for students to return each year. In the event that students do not return, the research will still be valuable because informal learning, “is cumulative and iterative, an ongoing, lifelong process rather than a single event” (Diamond et al, p14).

Qualitative methods used to determine if students are progressing in formal learning can allow for in depth individual cases, using interviews. Considering that program evaluators would likely not engage in observing students in their formal school settings, direct or indirect interviews would be valuable. Questions for the teen participants could focus on how they feel about the informal learning process, and if they have noticed a boost in grades or confidence within their formal settings. Interviews can

be in person, or through a testimonial after the program has ended where the teen would have the opportunity to talk about what they have learned, how they felt about the program, if they would change anything, or if they think coming back in the future would increase their knowledge and skills.

Quantitative methods that will be useful for this program are tracking teen school performance. Asking permission from teens to have access to their unofficial transcript each semester would track numerical patterns in data. This data would aid in answering the question of teen performance throughout the program and offering conclusive data of their formal learning. If the data shows an increase in overall performance from most participants over time it could conclude that the program is effective.

Comparing notes from the beginning and end of the program could show insights in teen confidence within themselves. Observing teens in the beginning of the program, how they enter the room, who they sit with, how they interact, are all valuable insights of each teen. These observations however do not give conclusive evidence of a teen's personality, but they offer a view into the comfort level of each participant in the beginning of the program. At the program's end observing teens in the same way, entering the room, who they sit with and how they interact could be vastly different from the beginning of the program, showing positive or negative changes in comfort level and confidence.

Keeping running records of observations during the program are an important tool to assist in the planning of future iterations of the program. While the program is running, noticing anything of importance and keeping a journal can be an invaluable research tool. After each session, writing out a reflection of the day, how the general vibe of the room

was, and any noticeable interactions will help guide educators in planning for future classes. In all cases, research is most effective when there is lack of bias. When recording, it is important to protect the identity of each student by using false names, however it will be valuable to the research to include the correct ages of the students in order for an accurate population sampling. It is imperative that the teens understand when you are writing down observations or notes, and if any student wants to opt out of the research they will have the opportunity to and will not be included in any aspect of the research. Selecting a representational sample from your students will allow you to claim that the sampling mirrors the overall teen population of Queens. If the research does show that *Teens in Queens* informal learning increases formal learning, there will be the potential for further funding and increase in teen applicants for future years.

IX. Reflection

I am proud to say that I was born, raised, and still live in Queens, New York. It is a part of me that feels like a part of my personality. When I talk with my friends who are from Queens, or meet people that grew up here there seems to be an instant chemistry. It is mostly a silent communication, our eyes meet and we seem to understand one another. My closest friends are people I grew up with. That's not to say I have not met outstanding people from other places, there is just something special about people from Queens.

There is also a uniqueness about attending public school in Queens. Because we are one of the most diverse places in the world, so are our classrooms. I remember in elementary school trading my peanut-butter sandwich for kimbap, empanadas, or curry. I learned phrases in different languages through my peers, and helped them with their English. I did not understand that my classroom environments were not typical.

I am passionate about Queens, but not about its public schools. Our schools are crowded, they are short staffed, teachers are frustrated and stressed, and students find it incredibly easy to slip through the cracks, which there are many of. How do we fix this problem? I don't have the answer to that, but I do think that with *Teens in Queens*, I can offer a way that students going to school in this borough feel a little less lost in the system.

My inspiration for this program came as a way to remember what my life was like in middle school and what I could have done to improve myself. Like other students, I felt alone in the classroom. I was let down by multiple teachers when asked for help, and because of their lack of engagement I began to fall behind, ultimately leading to a drop in grades and not getting into any colleges that I applied for. It wasn't until I graduated from

Community College and entered Queens College that I finally found educators that cared about my interests and goals.

Maxine Greene, a writer and educator wrote about the feeling of wide-awakeness, in which she believed everyone can have a moment where their lives can be changed in a cultural institution. In an interview published in 2014, she spoke about the importance of the imagination, “I feel that because of neglect of imagination, the neglect of thinking in terms of possibility, children think that what happens in school is totally irrelevant to them and to their future. There’s nothing worse for education than a feeling of futility.” I believe what she describes here, a feeling of futility, is something that many public school students feel at some point. If you asked my younger self if math was going to be important in my adult life I would have said absolutely not. I believe this answer is given when educators fail at having their students *see* math, failing at relating it to their own lives, only teaching from a book and not enticing their imaginations.

I found that feeling of wide-awakeness for the first time at the Brooklyn Museum. My first internship, I remember walking through the galleries inspired by every single work of art in the museum. Each painting took my breath away, and I knew that I wanted to share this world with others that might not have the opportunity. I knew that museums would never fail me, or anyone else that sought engagement and inspiration.

I want to be a museum educator because I understand what museums can offer the public. The fact that Queens, New York is home to large cultural institutions varying in content is something that all students from New York should experience, especially students from Queens. Creating *Teens in Queens* has been a passion idea of mine for a long time, but interning at the New York Hall of Science sparked my imagination of what

the program could truly look like. The work that the New York Hall of Science does with their surrounding community is important and inspiring.

For a long time I was envious of people who were passionate about one thing. Whether it be studying a specific animal, like learning about the sounds of dolphins, or educating yourself on the intricacies of robotics, or reading everything Shakespeare wrote multiple times trying to decode every verse. I never felt like I had a passion for just one thing, but the longer I think about it, what I'm passionate about most is Queens, and how I can help it be a better place for its students, introducing them to one museum at a time.

X. References

Blueprint for Teaching and Learning in Visual Arts (Grades 7-11)

Available From: <http://schools.nyc.gov/offices/teachlearn/arts/blueprints/visual-arts-blueprint.html>

City Data. (n.d.). Queens Borough, Queens County, Corona New York. Demographic and transportation data of Corona, Queens Residents Estimates (2016).

Available from: <http://www.city-data.com/city/New-York-New-York.html>

Dewey, J. (1916). *Democracy and education*. New York, NY: Macmillan.

Dewey, J. (1938). *Experience and education*. New York, NY: Collier.

Diamond, J. (1999). *Practical evaluation guide: Tools for museums and other informal settings*. Lanham, MD: AltaMira Press.

Dierking, L. D., and Falk, J. H. (2003). "Optimizing Youth's Out-of-School Time: The Role of Free Choice Learning." *New Directions for Youth Development* 97: 75–89.

Erickson, M. and L. Hales. (2014). Teens artists: Impact of a contemporary art museum. *Studies in Art Education* 56(1): 412–425.

Falk, J., and Dierking, L. (2000). *Learning from Museums. Visitor Experience and the Making of Meaning*. Lanham, MD: AltaMira Press.

Freire, Paulo (2005). *Teachers as cultural workers*. Boulder, CO: Westview Press.

Greene, Maxine. "Teaching the Art of Wide-Awakeness" (2012).

In: *Independent School*, Fall 2014, Vol. 74 Issue 1, p122-126.

Hornbya, J. and Bobickb, B. (2016). "A Survey of Teen Museum Education Participants and Their Parents." *The Clearing House*. Vol. 89. Issue 4-5. 153-158.

Kusuma, Krista Dahl & Wyrick, Gabrielle (2014). Real teens, real Tours: teen engagement strategies for the one-time visit. *Journal of Museum Education*, Special Issue: All Together Now: Teens and Museums, Volume 39, Issue 3, 2014.

- Maker Education Initiative.
Retrieved from: <http://makered.org/wp-content/uploads/2017/09/Maker-Education-Initiative-2016-Annual-Report.pdf>
- Muus, R. (Ed.) (1998). Adolescent behavior and society: A book of readings. (5th ed.) pp.126-139. NY: McGraw Hill.
- NYC Department of Education. (2018). 2018 NYC middle school directory.
Retrieved from: <http://schools.nyc.gov/NR/ronlyres/2193192A-89B7-4467-B40C-480750CEE5FC/0/2018NYCMSDDirectoryDistrict2ENGLISH.pdf>
- New York State Common Core Learning Standards (Grades 7-11)
Available From: <https://www.engageny.org/resource/new-york-state-p-12-common-core-learning-standards/?combine=science>
- Queens County Farm Museum. (n.d.). History of Queens County Farm.
Available from: <http://www.queensfarm.org/>
- Rose, Sarah. (2016) Museum–University Partnerships Transform Teenagers’ Futures, *Journal of Museum Education*, 41:4, 286-292,
Retrieved from: <https://doi.org/10.1080/10598650.2016.1232510>
- Simon, Nina. "Teenagers and Social Participation," in *Museum 2.0* (July 2010).
Retrieved from: <http://museumtwo.blogspot.com/2010/07/teenagers-and-social-participation.html>.
Accessed April 13, 2018.
- Steele, K. (2013). "What We Think Actually Matters? Teen Participatory Design and Action Research at the Free Library of Philadelphia.
- U.S. Census Bureau. (n.d.). Queens Borough, Queens County, New York: ACS demographic and housing estimates: 2012-2016 American Community Survey 5-Year Estimates.
Available from: <https://factfinder.census.gov>
- Waloff, C. (2013). Enhanced Participation: Creating Opportunities for Youth Leadership Development. Occasional Paper Series, 2013 (30).
Retrieved from: <https://educate.bankstreet.edu/occasional-paper-series/vol2013/iss30/9>

XI. Appendix

Original Lesson Plans

A) Journal Making- New York Hall of Science

Overview:

Making a journal is always the first thing we do in our afterschool programs. It's a good introductory activity because it provides plenty of opportunities for success and is open enough to allow for plenty of variation. Students will use a variety of tools and materials to make their journals, then spend some time personalizing it with decorative flair, buttons, stickers and whatever else they come up with.

Materials (per student)

1 sheet of Cardstock for cover

10 Sheets of paper

embroidery floss

Embroidery or tapestry needle

binder clips

large nail

hammer

foam block

Scissors

Optional Materials for personalization:

Markers

Washi tape

Stickers

Buttons

Elastic cord

Different colors of duct tape

Key Vocabulary:

Sewing

Binding

Hammer

Needle eye

Iteration

Diagram

Design

Introduction/Discussion:

We begin each activity with a group discussion, in a circle on the floor. We often use large mats or carpets to sit on, mostly because the students in New York won't sit directly on the ground.

Begin the activity by asking students if they've ever had a really great meal. This will open up the room for discussion, and allow the students to discuss personal and shared experiences. Ask them what the meal was, and how it was made. You can follow up by asking how we pass down recipes and ideas from one person to another. Typically students will say through cookbooks or notecards. You can then introduce the idea of recording ideas rather than recipes, and ask students where we would do something like that. Ask which of them use a notebook or a journal, and what they use it for. You'll likely get examples about school notes, and diaries and through discussion should come to the idea that notebooks and journals are places where we can record information we don't want to forget and keep records of our ideas to go back to later. You should have samples of journals to use as a model if you find it helpful. Explain that today we're going to be making science journals of our own, they're going to be personalized and we will be using them to record our thoughts, ideas, feelings and drawings throughout the program.

Exploration: Properties of Materials

Begin by showing the students a sample notebook, you can pass around a few examples for them to look at and explore. What's it made of? How was it made? What tools do you think you would need to make this?

Use the large scale model of the needle and thread to demonstrate how to thread a needle.

Show them how to sew the binding of the large scale book (cardboard mock up).

Another approach is to ask for two student volunteers and have one thread the large scale needle and the other one can try sewing the large scale book made out of cardboard.

Show students the hammer. What is a hammer for? Why would we need a hammer to make a journal? We are going to use the hammer to drive nails through the binding of our journal so it is easier to sew the binding. Explain that hammers are usually used to drive nails into wood, but today we're going to use them to hammer through paper into the foam. Ask - What material do you think is harder, wood or foam? Which material would require more force to hammer into it? For this project we only need to tap gently on the nail to punch the holes through the paper. What would happen if we used too much force on the nail? Once you've explained how the tools are used you can go through the process of the build.

From the discussion the group should have revealed all the materials necessary to make their journal. You can also have journal samples at the tables they can reference if needed.

Start Making:

Go over the steps below verbally with the students, introducing each step and how it leads to the next. Then have them gather all their materials and start making!

1. Start by folding just your card stock cover in half by lining up the far corners.

Once folded slide the craft stick down the fold to make sure it is a straight edge.

2. Fold all 10 sheets of paper in half in the same manner. You can do it individually but we would suggest doing them all together.
3. Open the cover and insert your 10 sheets of paper. Use a binder clip to secure the cover to the inserted pages. Typically one on the top and one on the bottom works well.
4. When you've got your pages all clipped up, lay your booklet open (paper side up) on your foam block, lining up the crease from the folds with the foam (we're about to hammer into it so you want to make sure they're lined up).
5. Start your first hole at the top of the binding in the crease. Hammer the nail all the way down, through all of the pages and your backing. It's alright if it goes into the foam. That's what it's there for. Pull the nail out and move it down the seam about a half an inch and add another hole. Continue in this manner until you've reached the bottom of the page. You can make as many holes as you want, the more holes the stronger the binding and the longer it will take to sew.
6. Time to cut your thread and thread the needle. The appropriate length of thread always turns out to be about the length of your outstretched arms. So grab the end of the thread, and unroll slowly with the other hand until your arms are stretched wide, snip it off and you're ready to thread your needle. Embroidery needles have a slightly larger eye and are therefore a bit easier to thread, however a needle threader is always helpful. No matter how you do it, once you get that thread through the eye you want to pull it until it's doubled and then knot the two ends together.

7. Once your needle is threaded and your knot is tied you can begin sewing the binding. We suggest start with the knot on the outside (meaning the cardstock side) and go up through to the paper. Make sure you're going through all the layers here from the backing all the way up through all ten sheets and pull until the knot reaches the backing. Then go back down through the next hole in the paper and pull until taught again. Continue in this fashion until you've reached the opposite end of the book then go back the other direction toward where you started. This time you want to sew in and out of every opposite hole thereby closing up the white space gaps between the binding thread. When you get back to the top where you started tie a knot cut the remainder of the thread off, or leave it, sometimes a longer thread is nice for a bookmark.
8. Take binder clips off and you're done making it. You may now personalize your journal with available materials.

Helpful Hint: Set up materials in designated place allowing them to select their materials and return to their table to work on their project. This a fairly materials intensive activity, and it is helpful to have a clear workspace free of clutter or excess materials.

Reflection Prompts:

Now that students have journals they can write their first reflections. We try and keep journal prompts fairly open ended but always encourage students to write what they made and how they made it. They can write, diagram or do some combination of the two. Explain that diagramming and journaling help us to make changes in the future, and

remind us of our process. After students have journaled, invite them to share their responses and processes from the day in a group discussion and reflection.

What did you make?

How did you make it?

What tools did you use? How did you use them? How might you use them in the future?

What materials did you use?

What might you change in the future?

What was challenging?

What was easy?

Did anything surprise you?

B) Introduction to 3D Printing- New York Hall of Science

Overview: This is the first time the makers will officially be actively engaging in learning about the 3D printer. There will be three different activities in order to help engage and understand the possibilities of the 3D printer. The goals of these activities are to explore how the 3D printer works, what are the parts of the 3D printer and how to create designs using the specific tool. Makers will engage in a layering activity, kinesthetic activity, and hot glue activity to help understand the most successful ways to create an object by thinking about surface area, overhang and orientation. Makers will think about how using layers of the same material can help create a 3D object.

Materials (Per student):

Activity 1: Layering shapes with foam

6 Foam Squares

1 Scissor

Activity 2: Kinesthetic Shapes

The only materials used will be their bodies!

Activity 3: Hot Glue Creations

A piece of wax paper

Duct tape- to secure wax paper on table

Pencil

Hot glue guns

While the kinesthetic activity is going on, have someone set up the hot glue guns on two different tables. Use the 4 prong extension cable to set up 4 hot glue guns per table. May need more depending on the size of the group.

Key Vocabulary:

3D Printer

Extrude

Layer

Printer Bed

Surface Area

Overhang

Orientation

Introduction/Discussion:

Have a 3D printer running and ask the makers to explore the room with their eyes, what tools do they see? When looking at the 3D printer, have them observe and react to how the printer moves, what do they notice? Some words they might say: pulley, motor.

Say the word extrude. What other words start with ex? What could extrude mean?

Hopefully the makers will observe that the printer extrudes the plastic, heats it up so the plastic melts in order to take shape, then cools it down on the printer bed, finally forming a layered solid object.

Ask the makers what they think would happen if the plastic would come out all at once quickly? They should understand that it would not be able to take shape.

What is a layer?

The first thing the machine does it create a base layer. Then it will build up in layers to create the design in the computer. Each time it lays down a new layer, that layer will cool down and harden. The layering process will continue until the shape is complete.

Is something that is made of layers weaker or stronger than one solid object? Have ready a layered 3D printed object, and a solid object so the makers can compare.

3D printed objects are weaker due to the layers, which is why we have to think about how we design the object to make it as strong as possible.

Let's Start!

First Activity (about 20 minutes): Layering shapes with foam

Picture a shape that you can create in layers. Use an example a maker offers.

ex: Sphere

How would you begin to create a sphere? You might start with a small dot, then build up with larger pieces. You could also start with a very large circle then build up using smaller pieces.

The constraints of this activity is that each maker is only allowed 6 pieces of foam, so they have to think about how to use the materials effectively to create what they want.

Pass around examples of layered shapes makers have created in the past.

The makers will cut out their shapes, and stick them to each other by peeling off the backs of the foam.

Once they are finished, choose an example of one that has a strong surface area and little overhang, if possible and one example with an excess of overhang and small surface area.

Helpful Hint: Make sure that we are acknowledging the makers hard work, and all examples are valid, however we want to make sure everyone understands how to most effectively create a design for the 3D printer. At the end of the day, all makers should have gained an understanding of surface area, overhang and orientation that work for the tool they will be using.

Surface Area- Area of the base of the object. The amount of space that the bottom of the model is touching the bed of the printer.

What will happen if the base of the object is too small? - The object won't sustain the balance if the surface area is too small and will collapse.

Overhang

If we think about the printer moving in layers, we have to think about overhang. Imagine a balcony or fire escape on a building. The fire escape hangs outside of the building, which is overhang.

If the object has too much overhang, what happens to the area underneath? - If there is nothing under to support the overhang, that area will collapse. Think of creating a shape with as little overhang as possible.

Orientation

Orientation is the direction something is facing. Have the makers hold up their created layered objects. Have them turn it 360 degrees, then 90 degrees. Have them move it upside down, or on its side. Ask them the differences between the rotations. What would be an ideal orientation for the designs?

Kinesthetic Activity

In order to reinforce the vocabulary words, have all of the makers go outside into the sandpit. Ask them to position themselves into a shape with their bodies. Once they position themselves, tell them "Ok, see ya in 2 hours!" Ask them who would feel comfortable being left for 2 hours in their shape? Their reactions will help them better

understand these vocab words. The makers laying down should feel the most comfortable because they have a large surface area with little to no overhang.

Ask them to stand in a position with strong surface area and no overhang.

Now ask them to stand in a position with little surface area and a lot of overhang.

Using that example, are there any students who could turn their orientation to better support themselves?

An example from a past group: A maker was in a back-bend. He was asked if he could change his orientation to have more of a surface area. He understood that he could flip to his stomach and lay with his legs and arms up. Flipping his orientation created the same shape, but in a different position to better support his design.

This activity will help the makers understand how important surface area, overhang and orientation are to their designs.

Once everyone has demonstrated during the kinesthetic activity, have the makers return back to their rooms where hot glue guns will be ready to create their next and final activity.

Hot Glue Gun Activity

Makers will create a 3D shape by layering hot glue.

1. Draw a desired shape on the wax paper.
2. Once you have penciled a shape on the wax paper, begin hot gluing the frame of the shape.
3. Once the base layer has dried, begin layering the shape with more glue, allowing each layer to dry a little before moving on.
4. The end result will be a 3D shape that they can pull off the wax paper and place in their project box.

Reflection Prompts:

What tools did we use today?

What did we learn?

What are the characteristics of a successful 3D print?

After discussion, reflect in journal, then place journal and 3D glue object in project box.

C) Introduction to Tinkercad- New York Hall of Science

Overview:

Makers will be introduced to Tinkercad, an online 3D CAD design tool, which can create a model to be 3D-printed. Students will have the opportunity to free-explore Tinkercad, and then be presented with a design challenge: to create a name tag only using simple polygons.

Materials:

- Assigned laptop, with username and password, per student

Key Vocabulary:

- 3D printer
- Overhang
- Surface Area
- Orientation

Introduction and Discussion:

Reflect on lesson from last week:

- What did we learn about and make last week?
- How does a 3D-printer work? How does it print its objects?
- What are the three things that we need to remember about 3-D printing?

*Demonstrate movement activity to help spark makers' prior knowledge

- Overhang
 - What does overhang mean?
 - How will it affect how the object is printed? Is it best to print an object with little or lot of overhang?
- Surface area
 - Is it better for objects to be laying down or standing up?
- Orientation
 - How does the position of an object affect how it is printed?

Using what we know about 3D-printers, we will use an online tool that can help us create a design for a 3D-printed object. Today, we will be working with laptops and this tools to explore more about how 3D designs are created.


Introduction to Tinkercad:

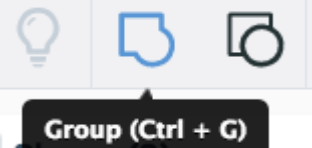
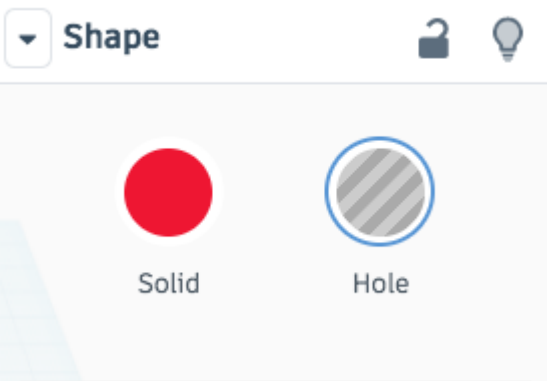
Ask students: Has anyone used Tinkercad? Can anyone describe Tinkercad? Tinkercad is an online tool that create designs for a 3D printer. What does it mean to tinker? What does it mean to CAD?

Distribute laptop computers to students. Establish classroom laptop norms (i.e. “What do I want to see on the screen? What are some sites that you should not be on while doing this activity?). Have students sign in to Tinker cad website using pre-assigned usernames and passwords.

Once all students are signed in, invite students to freely explore Tinker cad.

After some time, gather students together to explore about tools in Tinker cad that everyone should learn. Using the example of designing a house, discuss:

<p style="text-align: center;">Perspective</p> <p>Has anyone explored how you can view a design from different points? What tool is that on the site? Why is it important to view a design from different perspectives?</p> <p>Introduce the home button to students, or other related shortcuts (such as holding the CONTROL button and the mouse) to view different perspectives</p>	
<p style="text-align: center;">Changing Size</p> <p>Has anyone explored or found out how you can change the size of some shapes?</p>	

<p style="text-align: center;">Grouping</p> <p>This tool will group shapes together to make a new shape, one large piece, etc.</p> <p>It is imperative that the student's entire piece be grouped before it is 3D-printed.</p>	
<p style="text-align: center;">Creating a hole</p> <p>This tool can create a hole in shapes to create new shapes. What are some ways that you can use this tool?</p>	

Create A Name Tag:

Challenge students to create a name tag with just shapes. Include a base.

D) Composting and Seed Bombs- Queens County Farm Museum

Program Description

The powerful ecological value of compost comes to life in this hands-on workshop.

Through a series of exploratory activities, students engage with the compost exhibit and demonstration site to learn the basic science of compost. Farm educators teach how we make and use compost at Queens Farm and why it's important to divert food waste from landfills. Students and teachers take home a resource kit, to begin composting in school or home.

Note: This program can only accommodate one class per day (35 people maximum).

Learning Objectives

By the end of the program, students should be able to:

- Understand the difference between organic and inorganic matter
- Identify composting as a method of recycling organic materials
- Define compost
- Identify some decomposers

Duration

90-120 minutes total

10 minutes arrival & check-in

15 minute introductory discussion

30 minutes for exploration activities

20-25 minutes for seed-bomb making (2nd - 6th) OR campaign for compost (7th- 12th)

20-30 minutes for brief tour, hayride, and visit to restrooms

25 min for lunch

Materials

3 yellow wheelbarrows and wooden screen sifters, gloves, trowels, thermometers, magnifiers, shovels, clipboards and program worksheets, pencils, markers, supplies for post-exploration activity (either seed-bomb making or campaigning for compost)

- 2nd -6th grade makes seed bombs: clay, water, seeds, egg cartons, compost in 3 Tub rugs
- 7th- 12th grade creates campaign for compost: scrap paper, pens and markers

Preparation

Retrieve all program materials and visual aids from storage area in the compost area and the hangar (Operations maintenance building). Get any printed worksheets you may need (Education Coordinator can printed if needed). If making seed bombs bring 1-2 buckets of water over to site.

Prop open the worm bin and arrange wheelbarrows and sifters. Prep materials for the post-exploration activity. Ask supervisor to radio Operations for tables if needed.

Arrange clipboards and supplies on tables in the demo site.

Program Structure

- Introductory discussion: Welcome students to the Queens Farm compost exhibit and demonstration site. Ask them if they know why they are visiting today. Take responses from several students.
- Discuss waste, define compost, have a discussion using the guiding questions and activities below
- Break students into two groups for their exploration activities. There are two stations and students should spend about 15 minutes in each station. Ask the classroom teacher to facilitate the signage exploration.
- Bring students back together and outline their post-exploration activity
- Hayride (if booked)

Introductory Discussion: Guiding Questions & Activity

Ask Students: What have you thrown away today? Have you recycled anything today?

We call these things waste materials: any items we no longer find useful and we want to throw away. How do we dispose of waste? By reusing, recycling, composting, burning, putting it in a landfill. All of these have impacts on the environment

Most of NYC's waste is transported by barge or truck to landfills or incinerators outside of the city. This system requires a lot of fuel- which is a nonrenewable resource. How can we reduce waste?

Reduce waste before it happens: consume less, reuse what you can, recycle as much as possible. Today we're going to talk about a particular type of recycling, the recycling of organic materials, or composting!

Ask students: What does the term "organic materials" mean?

Anything that is a living thing or was once alive. You and I are made of organic material. What else is made of organic material? Plants, animals, people etc. What is not organic material? Metal, glass, plastic rocks, etc. We call these things inorganic. We want only organic things in compost.

Ask students: What is compost?

Here is an example of finished compost. Let them touch it, smell it, etc.

"It looks like soil, is made of recycled food scraps, garden amendment"

Definition: compost is a dark brown, earthy-smelling, and nutrient-rich material. It is a fertilizer and key component of healthy soil, which is essential to farming and the planet.

What is soil? The upper layer of earth in which plants grow, a black or dark brown material typically consisting of a mixture of organic remains, clay, and rock particles.

Composting is the speeding up of the way nature recycles organic materials. In nature, when leaves or other organic materials fall to the forest floor, they slowly break down and are consumed by a range of decomposers. It is then worked back into the soil and its nutrients are used by other organisms. By composting home, at school, or on a farm, we are able to control the types of materials, moisture, heat, and air to speed up this process.

The final product can also be worked back into the soil to give necessary nutrients to vegetables and plants.

Ask students: What is compost made of?

A combination of food, water, air, and microorganisms

Ask students: what belongs in the compost pile? What should be recycled? What is trash?

Banana peel

Soda can

Fruit snack wrapper

Brown paper bag

Chicken bones

Leaves, grass clippings

Plastic bag

Plastic utensils

Newspaper

Soiled napkin

Apple core

Styrofoam plate

Egg shells

Onion skins

Oyster shells

Aluminum foil

Why do we make compost? Why is it valuable?

If these organic materials are going to a landfill now, won't they just decompose and turn into compost there? Unfortunately, this is not the case. When they are layered and compacted with other trash, they lack the oxygen needed to decompose. Instead of

creating a healthy amendment for soil, the organic material mixes with other materials in the landfill and make toxic liquids and gases that could pollute the surrounding environment. By composting we can reduce the amount of waste going to landfills, reduce the amount of fuel consumed in transporting the waste, and make a soil amendment to grow strong plants using these nutrients that would otherwise be wasted.

There are many ways to make compost at home, at school, or on a larger scale. Let's explore the compost exhibit to find out how compost is made at Queens Farm!

Exploration Activities: 2 stations (15 min each)

- 1) Explore signage in compost exhibit
- 2) Explore windrows & sifting area

Divide class into 2 groups. Have your teacher and chaperone take one group into the compost exhibit. Explain to group that they will explore the exhibit signs and answer the questions on their worksheet with their teacher. Farm educator takes other group to windrows. Switch after each group has 15 minutes at a station.

Station 1: Exploring signage

As one large group or in smaller groups. Have students find the following signs and answer these questions:

Sign 1: HOW IS COMPOST MADE?

What is the recipe for compost?

Sign 2: COMPOST CRITTERS sign

What are the three types of critters that help make compost?

Sign 3: TUMBLERS (included on Queens Farm Community Compost Program: Start Composting Here!)

How do the tumblers work?

Station 2: Exploring Windrows

First, lead group over to the ‘windrow’ sign. Have one student read aloud. Have each student write definition of a windrow on their worksheet.

Next, lead them over to the sifting station. Explain the purpose of sifting compost, the tools we will use, and the process of sifting compost:

- Purpose: Before applying compost to our growing fields, our farmers use screens and sifters to aerate finished compost. This ensures the compost is free of clumps, rocks and loose enough to spread evenly into our soil. Have you ever seen a weirdly shaped carrot? That’s a result of lumpy/rocky soil. At our sifting station, students will have the opportunity to practice sifting finished compost.
- Tools:
 - Wheelbarrow (one per 3 students)

- Screen (one per wheelbarrow)
 - Garden gloves (for each student)
 - Garden spade (shovel)
-
- Process: Place screen on top of wheelbarrow. Scoop three shovelfuls of compost from the ‘finished’ pile onto the screen. Using gloved hands, move compost around on the screen until smaller particles fall through and you’re left with only objects that are too big to fit through the screen.

After, have students explore the windrows on their own. Hand out magnifying glasses and trowels. Have them follow the directions on their worksheet, diagramming the space and writing notes on materials and/organisms they found and where. Have them also record the temperature of different sections of the windrows.

Post-Exploration Activities

Making Seed Bombs (2nd - 6th grade)

Once we have finished compost what do we do with it?

Yes, we mix it in with the soil on our fields to add vitamins and nutrients back in. This way our plants will grow nice and strong and we don’t have to buy fertilizers whether they be organic or chemical. Compost that we make is free!

So, today each of us is going to take compost home with us and start a little garden.

We're going to make something called a seed bomb.

Seed bombing was invented as part of a movement to make a city greener. People would make seed bombs to start gardens in places and spaces that are not easy to get to. This type of gardening allows people to easily spread plant seeds around. People in this city-greening group would throw seed bombs into abandoned lots, on sidewalks, in ditches. This seed bomb little package is made of clay, compost, and wildflower seeds! Seed bombs can usually grow in almost anywhere quite easily because the compost and clay provide nutrients and protection for a seed to grow.

You can plant them carefully in their gardens, throw it anywhere in their backyards, put them into containers of soil, throw it into an abandoned lot. Although it is easy for seed bombs to grow, they still need to be watered, by rain or by people.

Guiding Questions:

- What do your seeds look like?
- What are some things these seeds need to grow?
 - Water
 - Air
 - Sunshine
 - Nutrients from the soil
- What do you think they'll grow into?
- Why do we use clay and compost for the seed bombs?

- compost/soil provide nutrients for seeds to grow & are anchors for seeds' roots to grab on
- clay protects the seed, holds the seed and soil together, and provide extra support for seeds' roots

Instructions for making a seed bomb:

1. Roll a ball of clay
 2. Flatten it with your palms
 3. Add a pinch of compost on the flattened clay
 4. Sprinkle with water (too much water can drown the seed!)
 5. Add a tinier pinch of seeds
 6. Roll the ball of clay, compost, & seed together
-
- Demonstrate how to make one before handing any materials out
 - Hand out materials
 - Circulate and help the students with the activity
 - Traditional seed bombs are rolled into a spherical shape, but you can use your imagination and create other shapes
 - plant the seed bomb once it has hardened

Concluding Question: Where will you plant your seed bomb?

Campaigning for Compost (7th-12th grade)

Break students into smaller groups of 4-6 people each. Distribute handout. Briefly review the activity and let them know how much time they have to create their campaign.

Provide scrap paper, stickers, markers, pencils, etc.

E) Circuit Boards and Paper Circuit Lesson- NYSCI

New York Hall of Science and <https://tinkering.exploratorium.edu/circuit-boards>

BUILD IT!

Experimenting with batteries, bulbs, buzzers, switches, and other electrical components is a great way to start tinkering with circuits. Real parts mounted on sturdy wood blocks are designed for anyone to start creating electrical connections between everyday objects.

From the basic elements you can deepen the experiments by adding potentiometers, double-pole double-throw switches (DPDT), motors, resistors, and other scrounged inputs and outputs that can do interesting and sometimes surprising things when connected. The set of circuit boards is not only a compelling way to work with electricity, but the parts can also be used in many other tinkering activities.

TRY IT!

Getting started: The most important first step for the circuit board activity is to make sure that you have had some experience working with circuit boards as a learner yourself, in order to develop a basic understanding about what the components do and how you can get them to work. Getting started with others: Each person or team a couple of wires with alligator clip leads, a battery block, and a light bulb block. Ask if they can figure out a

way to connect the battery to the light bulb to make it light. Once someone is successful at getting the light bulb to light, offer them a motor block and ask them if they could now try to connect the motor to the battery to make it turn. When most of the group has had success with the light bulb and motor blocks, you could either introduce switches or more complicated components. Introducing Switches: The goal for this pathway of investigation is to develop switches, potentiometers, conductive materials, and sensors that control the flow of current to the outputs motors, lights, buzzers. Start by offering a third wire and a simple switch to incorporate into their simple circuit. Once there is some success with a simple switch controlling their simple take it further. Try the electrical switches that you collected and constructed or use conductive materials like aluminum foil as switches.

Start by challenging someone to connect a buzzer or doorbell after they have had success connecting the light bulb. Or offer the three-bulb block and ask for a solution where all of the lights can be powered by a single battery pack. All of the components have two pins/nails that can be used to connect them to the two pins/nails on the battery.

Sometimes switching the two wires om positive on the battery to negative on the battery will change the behavior of the component. Many components will only work when connected in one configuration. Encourage a variety of explorations with the components, and ask everyone to share discoveries with one another as they explore. This activity does not always follow a step-by-step pattern and many participants discover interesting things through simply messing around with the components on their own. This activity might also result in a wire or battery pack getting hot if someone creates a short circuit (the battery is connected directly to itself). Keep an eye open for this and point it

out in order to save precious battery life and prevent unexpected injury or component failure.

Organize a conductive scavenger hunt using a light bulb, battery pack, and two wires that can be connected to different objects to test their conductivity. Try making switches out of tinfoil, metal flatware, bottle caps, and other electrically conductive things (just be careful to not connect the two wires to another battery or external power source—that could be dangerous)

Build a test-kit for discovering interesting inputs and outputs. Having a battery block and a couple of wires handy when you are dissecting unused electronic items, household appliances, or mechanical toys will help you to identify and test the motors, switches, sensors, and other parts. Bring your test-kit to surplus stores, electronics shops, and even supply stores to find unusual new things to use with your circuit board set.

Incorporate individual circuit board components into other construction-based or tinkering activities. For example, you might use the battery packs and light bulbs in an explorations about kinetic light play, or integrate the found inputs and outputs into the chain reaction activity.

EDUCATOR ADDENDUM

A note on our philosophy: The Tinkering Studio is based on a constructivist theory of learning, which asserts that knowledge is not simply transmitted from teacher to learner but actively constructed by the mind of the learner. Constructionism suggests that learners are more likely to make new ideas while actively engaged in making an external artifact. The Tinkering Studio supports the construction of knowledge within the context of building personally meaningful artifacts. We design opportunities for people to “think with their hands” in order to construct meaning and understanding.

Activity Design (decisions and designs that support a tinkering experience)

Tinkering Studio activities and investigations are designed to encourage learners to complex their thinking over time. The variety of materials and variables available for experimentation allow learners to enter at a point where they are comfortable starting, and then alter and renew their designs as they develop new ideas. Tinkering activities are often, whimsical, inspired, and surprising.

The circuit board activity is one that allows for learners to choose their own pathway as they develop an understanding about the electrical components and test out the connections between them. This often leads to multiple pathways and discoveries being made by learners of all ages and backgrounds. Our goal is not to “teach” specific things about circuits, but to allow a first-hand understanding to develop over time.

Because there is a variety of more and less complex parts, learners of many different experience levels are able to find something to start with. This means beginners can start

with quick success, yet as ideas progress.

Trial and error is a key part of the circuit board activity. This is especially important in order to test assumptions and understanding later on. Batteries sometimes get hot when wires are crossed and bulbs sometimes burn out, but these are real and important outcomes of the ideas that many people have while exploring.

The nails, boards, and electrical components are a mixture of familiar and unfamiliar objects. Unfamiliar electrical components seem less intimidating when connected to a pine board with steel nails. Almost everything is visible, so the learner can actually trace the wires to figure out how things are connected.

There are no instructions and no pre-conceived “right” way to connect something at the start. The electrical components will either work or not, and allowing learners to connect something the “wrong” way is almost as useful as connecting something the “right” way. We are often surprised and delighted by the variety of ways that people use the circuit board components, and we wouldn’t want to do anything to design the possibility for discovery out of the activity.

Things that you might say and do at this stage:

- “Have you ever completed a circuit like this before?”
- If stuck and something isn’t working you might ask them to trace the wires to make sure there is a complete circular pathway (circuit) for the electricity.

- Sometimes things don't work because a wire is broken or a battery is dead. Suggesting to participants that they check these things early in their investigations will go a long way in helping them later on.
- Let people make simple discoveries for themselves, and allow learners the opportunity to be proud of small steps when getting things to work.
- Ask specifically what they are trying to do (if something isn't working), and ask them to show you how they have already completed a circuit like it with these materials. This way you can get a sense of how the learner is thinking about things.
- Sometimes a learner might make something work, but unintentionally. You might check this by asking them to apply the same wiring to another component.
- Allowing people to get stuck is important, and doing what you can to linger in that moment before you step in and "help" might go a long way toward developing confidence in the learner. Don't wait too long, however, because we don't want people to give up. This takes practice.
- Do what you can to offer suggestions along the lines of their current ideas. Try to resist offering YOUR solution to THEIR problem.

Later stage facilitation is also an opportunity to work out some of the misconceptions learners might have about electricity, or the lingering ideas about series and parallel circuits.

- Offer a challenge that is a little bit tricky. For example, ask them, “Can you make three lights turn on by wiring them three different ways?” (This is a way to explore parallel and series circuits.)
- Try sharing new ideas in non-verbal ways. For example, construct an interesting circuit or contraption next to them to see if/how they are able to observe and understand what you have done. Then you can talk about it with them.
- Ask if a learner might be willing to step in and help out someone else at the table. This is a good idea to allow them to put their new understanding to work, but be careful that they don't take over someone else's investigation.