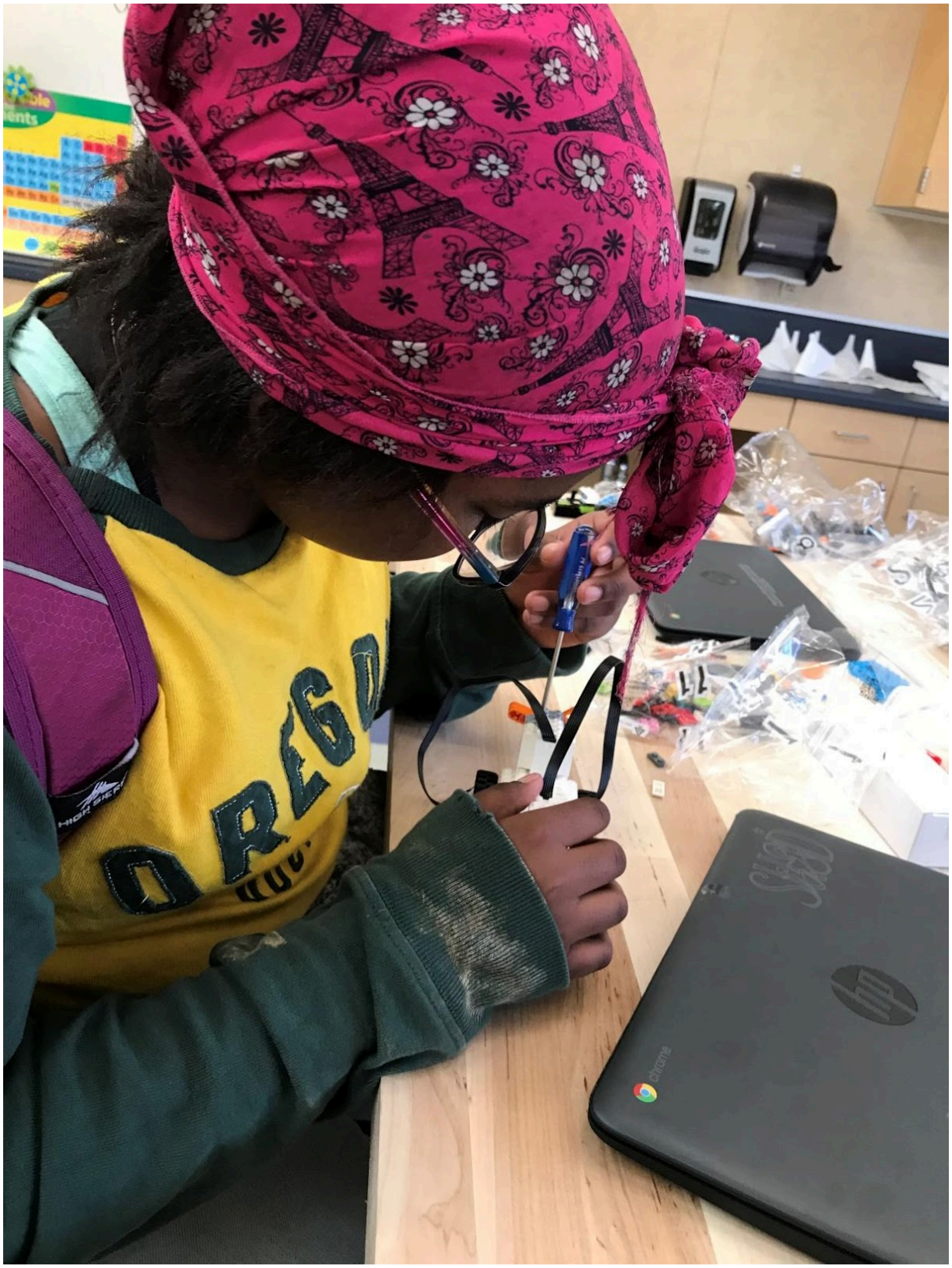
Developing an Elementary School Makerspace

Maridee Stanley



Kennedy Elementary Makerspace

I. Overview

A. Project. This project focuses on the development and implementation of a makerspace at an elementary school. Funding sources that assisted in making the space a reality are included, as are several NGSS 5E lesson plans that have been or will be implemented in the space. Finally, instructions on setting up a STEAM Night to showcase student projects created in the space are included.

B. Place. Kennedy Elementary is a Title 1 public school located in north Stockton. Although the north is generally viewed as the more affluent end of town, the neighborhood surrounding Kennedy is an island of poverty with the dubious distinction of having the highest homicide rate in Stockton. Bordered by low-end duplexes on the north and east and two blocks of Section Eight apartment complexes on the west, the Kennedy community is mobile, with home ownership the exception. Many immigrant groups have moved in, up, and out, their first stop on their way to the American dream. But some families get stuck here in generational poverty.

C. People. The student body at Kennedy Elementary is diverse, with 40.89% Hispanics, 25.36% African American, 15.89% Asian 6.07% mixed race, 5.18% white, 4.82% Filipino, and .18% Pacific Islander. All students are offered free breakfast and lunch. Very few have opportunities for enrichment activities outside of school. Some have never been outside their neighborhood. Therefore it is up to the Kennedy staff to provide exposure to the careers in demand in the 21st century and begin to build proficiencies so that students have the opportunity to pursue those careers.

D. Purpose. The purpose of the makerspace is to provide STEM experiences so that students build 21st century skills and begin to see themselves as the programmers, engineers, and scientists of tomorrow. Students are expected to communicate, collaborate, think critically, be creative, problem solve, and persevere. Failing forward is celebrated. The underlying goal is to use the makerspace as a tool to help break generational poverty.

E. Uses. This space has two primary uses. First, the makerspace is used by my three after-school STEM clubs: Coding Club on Mondays, Robotics Club on Thursdays, and Science Club on Fridays. Coding Club uses the tutorials of Code.org, Tynker, and Scratch for self-paced individualized learning. Currently, the 8th graders are working on game development using Scratch. They may move on to Net Logo, and some have expressed an interest in learning Python. Younger students are learning the basics of block programming. Robotics Club is currently using Mindstorms and LEGO WeDo 2.0 to build and program robots with Logo. We also have VEX robotics and hope to form a competitive VEX robotics team someday. Science Club does a wide range of STEM activities. During the first half of the year, activities are teacher-led to expose students to various potential career paths, develop good safety habits, and learn the scientific method and engineering design process. We have done everything from constructing and cooking in solar ovens, conducting chemistry experiments, modeling atomic structure, engineering roller coasters, making arcade games using physical computing and MakeyMakeys, building circuits, animal dissection to study comparative anatomy and animal adaptations…. The list goes on and on and includes classic science-for-kids activities, everything I have learned in my STEM master's classes, activities from Maker Magazine, the EEI curriculum, and the internet, and projects of my own invention.

The last half of the year is dedicated to facilitating the students' own projects. Students follow their own interests, are strongly encouraged to tackle real-world problems, and begin by reviewing the United Nations goals for a sustainable world.

Second, the space can be used by individual classes during the school day for NGSS lessons, or simply for tinkering as a reward for good behavior.

II. Rationale

A. Changes in the economy require changes in education. Once, teachers were dispensers of knowledge. Knowledge was power because it was a scarce commodity earned with effort. Then came the age of information. Facts were democratized. Need to know? Just ask Alexa. Facts became cheap. Now that information is found fast and efficiently on a phone, the role of the teacher as the dispenser of knowledge has faded. Education must adapt. Knowing is no longer enough. It is not what you know, but what you can ***do*** with what you know. The post-information age economy runs on "the next big thing". We have entered the age of innovation.

Robots have replaced assembly line and warehouse workers because robots work faster, longer, and without health care. Robots are in the process of replacing retail workers and will someday replace transportation workers. Artificial intelligence programs are replacing service workers and others. This trend will only accelerate. So what jobs must teachers prepare students for? We don't know because those jobs do not yet exist. But a good bet is our students will someday work in jobs where humans can compete robots. This will entail creativity, critical thinking, and problem-solving. Today's educators must foster tomorrow's innovators.

Innovation is a necessity for the 21st-century economy. "When accelerating change supplants incremental change as the norm, the capacity to innovate becomes essential for business competitiveness of the United States and indeed all participants in the global economy." (National Academies Press p.3) Today's big names in business such as Amazon, Apple, Google, and Facebook have a culture of creativity and even old-guard companies such as General Electric put a premium on innovation. (National Academies Press p.5) Not surprisingly, the National Aeronautics and Space Administration (NASA) measures its success by innovation and the inventions it generates. (Scolese)

B. **Makerspaces: innovation labs for today's students and tomorrow's workforce**

America built its supremacy on innovation. If the USA is to keep its edge, educators must encourage innovation in our students. How? Makerspaces in schools are a powerful tool with great potential to develop innovation and other 21st century skills in our students. "Future economic development and job creation are dependent on our ability to innovate and the maker movement exemplifies the kind of passion and personal motivation that inspires innovation" (Peppler & Bender, 2013, p. 23, quoting the New York Hall of Science). Makerspaces can help us reimagine schools to create a mindset of creativity and innovation. (Peppler & Bender, 2013)

In his 2016 proclamation *National Week of Making,* President Obama declared

> "Makers and builders and doers - of all ages and backgrounds - have pushed our country forward, developing creative solutions to important challenges and proving that ordinary Americans are capable of achieving the extraordinary when they have access to the resources they need. Let us renew our resolve to harness the potential of our time - the technology, opportunity, and talent of our people - and empower all of today's thinkers, makers, and dreamers." (Obama, 2016).

What is a maker space? At its most basic, makerspace is self-defining: a place where people make things. Beyond that, definitions vary, agreeing only in that makerspaces can take a variety of formats from a simple rolling cart with craft supplies or LEGO robotics to a warehouse filled with the latest high tech fabrication tools. (Rendina, 2015) Some would limit maker spaces to high tech fabrication. (Hira & Hynes, 2018). MIT's Fab Lab is an example of a maker space limited to digital fabrication and computation. For others, anything goes, from cooking and crocheting to robotics and programming 3D printers. No matter how broad or narrow the scope, all maker spaces involve the sharing of both tools and ideas. Sharing equipment makes personal manufacturing feasible. The makerspace ethos encourages collaboration. (Smith & Light, 2017)

Makerspaces are the offspring of hackerspaces and the do-it-yourself movement and are the workspace for the maker movement. While Maker Media, publisher of Make Magazine and organizer of the first Maker Faire, likes to take credit for inventing the makerspace, its roots are much deeper, preceding written history. Several commentators have noted that "making" is intrinsically human. Humans are not the only species to use tools and embellish their nests, but we are the only species that is defined and shaped by the technologies we create.

III. History of the Kennedy STEM Lab

Iteration One. Believing students do not get enough science in most classrooms, I have always facilitated an after-school science club. Initially, the club was limited to 5th through 8th graders and held in my own classroom. When club projects began to clutter up my kindergarten class, I received permission from the principal to use an old portable as a dedicated science space referred to simply as "the science room". This was a happy place where we could spread out, spread our wings, and make messes. The science room acquired a small zoo of reptiles, amphibians, arthropods, small mammals, and worms. We did experiments, projects, and put on science-themed plays. Because the district was not funding any field trips or camps at that time, I also did my first two museum-style installations for the entire school. If our students couldn't get to nature, I would bring nature to our students. The first installation was on California forests and their resources, inspired by my time at the Forest Institute for Teachers. The second was on water and had a variety of hands-on activities as well as exhibits and information. The club grew in popularity, younger students begged to join, and it was necessary to split the club into two sessions: 3rd -5th grade and 6-8th grade.


Reduce
Reuse
Recycle
STOP Wasting
Start Walking
Use Alternative ENERGY
Buy Local Think Global

Iteration Two. A new principal wanted the science room for support staff offices, but I was offered an even older portable for a science room. Although the walls were moldy and the floor was so wavy that desk drawers slid open on their own, this may have been a blessing in disguise, as the room had more storage plus counters with open shelving. After bleaching the mold and removing the dead mice, I covered all wall surfaces with informational text and pictures and filled the shelves with displays. My science club continued to explore/work/play in the room, and I began to do regular installations for the entire school using the Stanford engineering design process. I did installations on biomes, animal adaptations, fundamental forces, and simple machines. In between those installations, we had tinkering. Each installation had a primary area, an intermediate area, and a middle school area with hands-on activities for each level. Science club members, who learned the activities first, served as docents when their class came for an in-school field trip. The science room was renamed the Kennedy Exploratorium. For a while, the installations were tied to a new writing program. Students would do the hands-on activities and read the walls, then return to their classrooms and write about their experiences. The writing program didn't last, but science became entrenched as part of the Kennedy culture.

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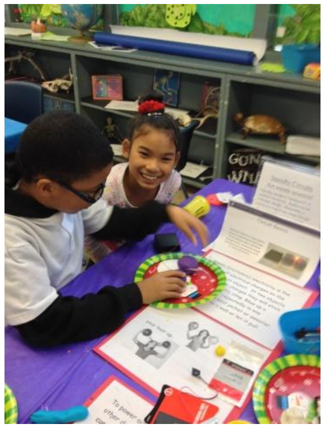
COLLEGE


ELECTRICAL
CIRCUITS






Then the old portable was torn down to make way for a new wing. By this time, the Exploratorium had acquired a great deal of STEM paraphernalia. I stored as much as I could in my classroom, under the school stage, and in a storage unit I rented for that purpose. But much of it had to be pitched or passed on as the school was very short on space during the construction phase. I lost a tremendous amount of work product. The animals were raffled off, habitats and all. The Science Clubs moved back into my classroom. The installations stopped… at least temporarily.

Iteration Three: Makerspace. The new wing that opened in the 2019/2020 school year has a dedicated science club room, and I commandeered the adjacent classroom as well. The old Kennedy Exploratorium had been very labor-intensive; I spent more time managing that than I did teaching full-day kindergarten. How could I make it sustainable? During the year of construction, when the science clubs met in my kindergarten room, our activities became very high-tech, as working on a computer is less messy than science. The senior members of the club have been working with me for four or five years and are ready to manage their own passion projects. It is time to morph the Exploratorium into a makerspace. A 3D printer and Raspberry Pi have been ordered and will join our existing class set of MakeyMakeys, circuit playgrounds, and a couple of Arduinos. Construction tools and a soldering iron have been added to our snap circuits, squishy circuits, and Chibitronics. Art supplies have been added to primary tinkering toys. I am gradually moving supplies out of storage and into our new space, replenishing chemistry supplies, and ordering new materials.

The students have evolved as well. Eight years ago, when I presented a design challenge to the first crop of Kennedy science club members, they would run up to me 60 seconds later saying, "I can't do it. Help me." I wouldn't. Today, the older members throw themselves on the floor, heads together, and figure things out for themselves. They are ready for Tinkercad. They will continue to grow now that they have access to more advanced tools.

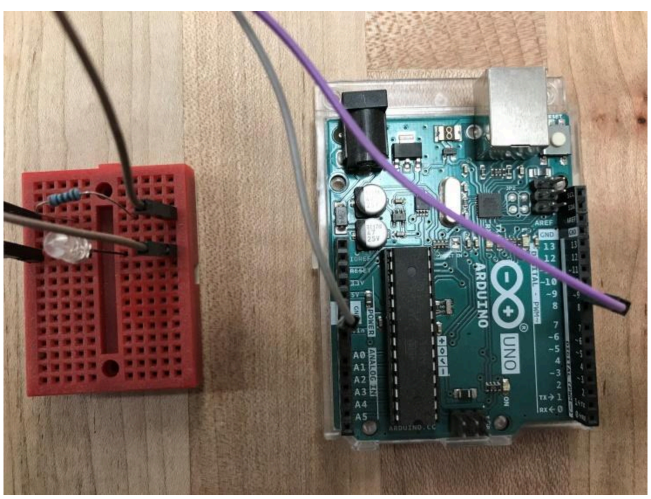
The new crop of 3rd graders, on the other hand, is a wild and crazy bunch who will need a lot of basic science. They have the older students to inspire them to explore, investigate, imagine, innovate, and create.

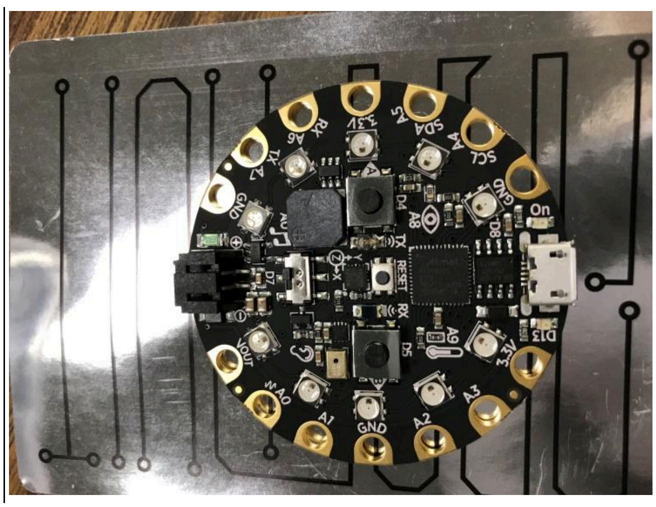
Student line up, permission slips in hand, waiting for the first science club meeting of 2019.

Kindergarteners extending a lesson on engineering by pondering the relationship between the structure and function of bones.


PHYSICAL SCIENCE
MOTION
STATIC ELECTRICITY


OREGON


ARDUINO
UNO


RX
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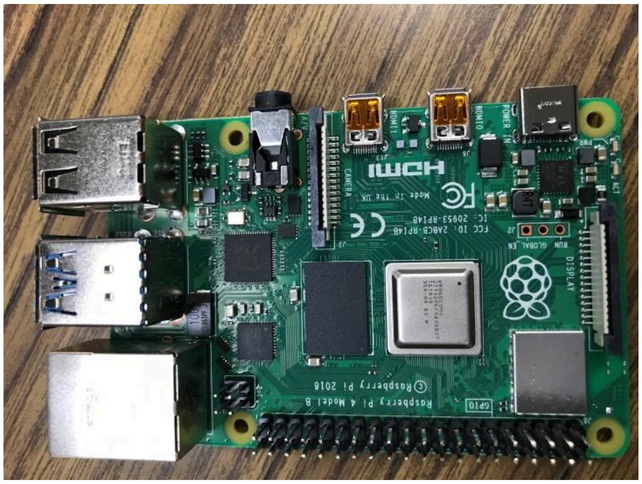
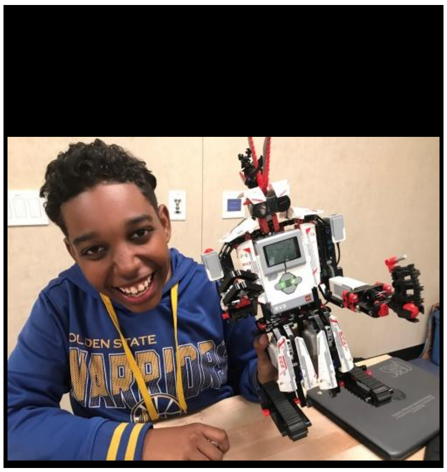








Science Club

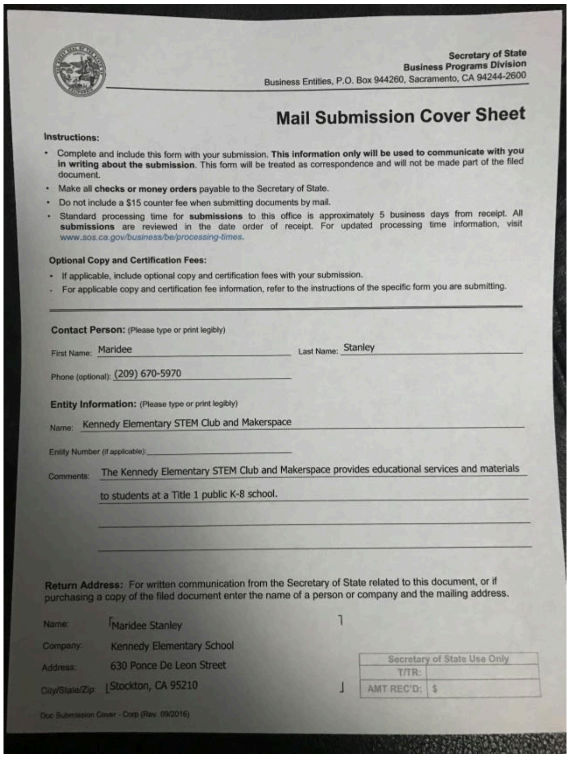
IV. Funding

All this costs money. Digital tools, such as the 3D printer, MakeyMakeys, and Circuit Playground tend to be pricey, but are a one-time investment. While we use recycled materials as much as possible, we also need an ongoing supply of consumables from batteries to building supplies. To date, my various STEM spaces have been primarily self-funded. But I did get financial assistance for some of the big items. The ***Light Awards*** is a wonderful organization to work with and provided a $30,000 grant for the Kennedy STEM Writing Project. Of that grant, $2,000 went for a class set of LEGO Education WeDo robotics. Contact Light Awards at https://lightawards.org/.

Donors Chose,

https://www.donorschoose.org , funded the 3D printer and a few small digital items. See my Donors Chose page at https://www.donorschoose.org/project/building-tomorrow-in-the-stem-lab/4209089/?utm_source=dc&utm_medium=page&utm_campaign=project&utm_term=teacher_6522772&rf=page-dc-2019-10-project-teacher_6522772&challengeid=21412651 .

To encourage donations on sites such as *GoFundMe* (https://www.gofundme.com/ (and see https://www.gofundme.com/share/s/share-family-friends/kennedy-elementary-stem-clubs-and-makerspace) I am considering forming a California Nonprofit Public Benefit Corporation and seeking tax-exempt status pursuant to California Revenue and Taxation Code section 23701d as well as 501(c)(3) of Title 26 of the United States Code. To that end, I prepared articles of incorporation using the state form ARTS-PB-501(c)(3). By becoming a 501(c)(3) organization, donors can deduct contributions as a charitable deduction on their taxes, a motivating factor. GoFundMe handles donations to registered 501(c)(3) corporations separately and differently from standard causes, increasing the net donation amount to the charity. But there are by-laws to write and filing fees to pay, so I must do a careful cost/benefit analysis to see if this process will pay off.



Secretary of State
Business Programs Division
Business Entities, P.O. Box 944260, Sacramento, CA 94244-2600

Mail Submission Cover Sheet

Instructions:

- Complete and include this form with your submission. **This information only will be used to communicate with you in writing about the submission.** This form will be treated as correspondence and will not be made part of the filed document.
- Make all **checks or money orders** payable to the Secretary of State.
- Do not include a $15 counter fee when submitting documents by mail.
- Standard processing time for **submissions** to this office is approximately 5 business days from receipt. All **submissions** are reviewed in the date order of receipt. For updated processing time information, visit www.sos.ca.gov/business/be/processing-times.

Optional Copy and Certification Fees:

- If applicable, include optional copy and certification fees with your submission.
- For applicable copy and certification fee information, refer to the instructions of the specific form you are submitting.

Contact Person: (Please type or print legibly)

First Name: Maridee Last Name: Stanley

Phone (optional): (209) 670-5970

Entity Information: (Please type or print legibly)

Name: Kennedy Elementary STEM Club and Makerspace

Entity Number (if applicable):

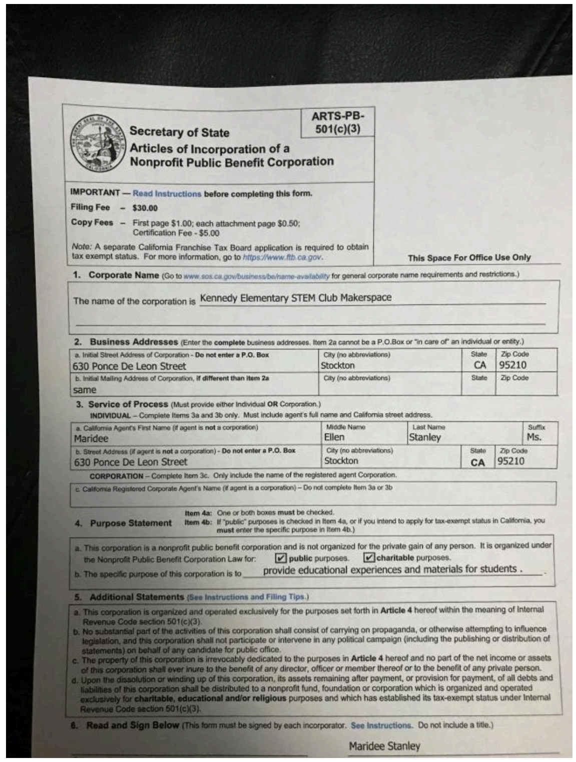
Comments: The Kennedy Elementary STEM Club and Makerspace provides educational services and materials to students at a Title 1 public K-8 school.

Return Address: For written communication from the Secretary of State related to this document, or if purchasing a copy of the filed document enter the name of a person or company and the mailing address.

Name: Maridee Stanley
Company: Kennedy Elementary School
Address: 630 Ponce De Leon Street
City/State/Zip: Stockton, CA 95210

Secretary of State Use Only	
T/TR:	
AMT REC'D:	$

Doc Submission Cover - Corp (Rev. 09/2016)



Secretary of State
Articles of Incorporation of a Nonprofit Public Benefit Corporation

ARTS-PB-501(c)(3)

IMPORTANT — Read Instructions before completing this form.

Filing Fee – $30.00

Copy Fees – First page $1.00; each attachment page $0.50; Certification Fee - $5.00

Note: A separate California Franchise Tax Board application is required to obtain tax exempt status. For more information, go to https://www.ftb.ca.gov.

This Space For Office Use Only

1. **Corporate Name** (Go to www.sos.ca.gov/business/be/name-availability for general corporate name requirements and restrictions.)

The name of the corporation is Kennedy Elementary STEM Club Makerspace

2. **Business Addresses** (Enter the **complete** business addresses. Item 2a cannot be a P.O.Box or "in care of" an individual or entity.)

a. Initial Street Address of Corporation - Do not enter a P.O. Box	City (no abbreviations)	State	Zip Code
630 Ponce De Leon Street	Stockton	CA	95210
b. Initial Mailing Address of Corporation, if different than item 2a	City (no abbreviations)	State	Zip Code
same			

3. **Service of Process** (Must provide either Individual **OR** Corporation.)

INDIVIDUAL – Complete Items 3a and 3b only. Must include agent's full name and California street address.

a. California Agent's First Name (if agent is not a corporation)	Middle Name	Last Name	Suffix
Maridee	Ellen	Stanley	Ms.

b. Street Address (if agent is not a corporation) - Do not enter a P.O. Box	City (no abbreviations)	State	Zip Code
630 Ponce De Leon Street	Stockton	CA	95210

CORPORATION – Complete Item 3c. Only include the name of the registered agent Corporation.

c. California Registered Corporate Agent's Name (if agent is a corporation) – Do not complete Item 3a or 3b

4. **Purpose Statement** Item 4a: One or both boxes **must** be checked. Item 4b: If "public" purposes is checked in Item 4a, or if you intend to apply for tax-exempt status in California, you **must** enter the specific purpose in Item 4b.)

a. This corporation is a nonprofit public benefit corporation and is not organized for the private gain of any person. It is organized under the Nonprofit Public Benefit Corporation Law for: ☑ **public** purposes. ☑ **charitable** purposes.

b. The specific purpose of this corporation is to provide educational experiences and materials for students .

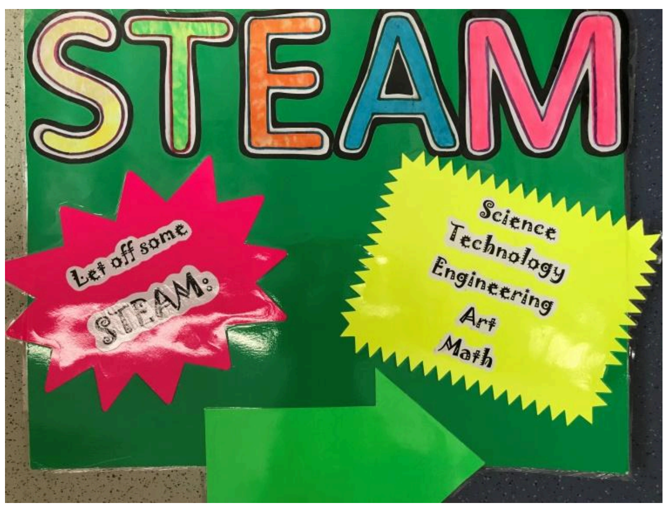
5. **Additional Statements** (See Instructions and Filing Tips.)

a. This corporation is organized and operated exclusively for the purposes set forth in **Article 4** hereof within the meaning of Internal Revenue Code section 501(c)(3).
b. No substantial part of the activities of this corporation shall consist of carrying on propaganda, or otherwise attempting to influence legislation, and this corporation shall not participate or intervene in any political campaign (including the publishing or distribution of statements) on behalf of any candidate for public office.
c. The property of this corporation is irrevocably dedicated to the purposes in **Article 4** hereof and no part of the net income or assets of this corporation shall ever inure to the benefit of any director, officer or member thereof or to the benefit of any private person.
d. Upon the dissolution or winding up of this corporation, its assets remaining after payment, or provision for payment, of all debts and liabilities of this corporation shall be distributed to a nonprofit fund, foundation or corporation which is organized and operated exclusively for **charitable, educational and/or religious** purposes and which has established its tax-exempt status under Internal Revenue Code section 501(c)(3).

6. **Read and Sign Below** (This form must be signed by each incorporator. See Instructions. Do not include a title.)

Maridee Stanley

How to Create a S.T.E.A.M. Night



STEAM Night (Science, Technology, Engineering, Art, and Math) is a great vehicle to showcase your students and school, increase parent participation, and build school spirit. At our site, a diverse Title 1 school, our annual STEAM Night has become so popular that a large crowd forms at the entrance gate before opening and the cafeteria is so packed it is difficult to worm your way to the tables for the activities. This is a school that has been unable to sustain a PTA, where attendance is a problem, and where parents often miss their own children's SSTs. But the whole neighborhood turns up for STEAM.   Parents work together with their children for an enjoyable evening of hands-on learning.

STEAM Night is, however, a huge undertaking that requires significant planning and preparation. The first year is the most difficult as you build a repertoire of activities and a network of volunteers and suppliers. Expect a few glitches. But the work is worth it. Below are suggestions to implement a STEAM Night at your school.

Get administration buy-in. You will need your principal on board. Administration is needed to keep the cafeteria open after hours, encourage teachers to volunteer their time, advertise on the marquee, help coordinate a feasible date, and possibly move the after school programs out of the multipurpose room for one afternoon. Usually admin is enthusiastic about a STEAM Night. If not, point out that STEAM Night demonstrates your school is doing its part to prepare students for 21st century jobs which helps the school hold on to its top students.

Get teacher buy-in. Science is messy. To assure stations don't get out of control, it is best to have a teacher manage each activity. One year, when we were short on teacher volunteers, science club members manned the stations in lieu of adults. They complained "No one is listening to directions."   Teens from another school got carried away at the Oobleck table.   The principal and I were mopping gak off the floor until 11:00pm. Now I make sure an adult with management skills oversees each activity. To encourage teachers to volunteers their time, emphasize that STEAM Night is an opportunity to build positive relationships with parents and students. It should also satisfy mandatory parent contact hours if required by your district.

Decide on your goals and set the date accordingly. Early in the school year, or even before school starts, work with your principal to select a date. Is your primary purpose for hosting a STEAM night to build community and increase parent involvement? If so, consider holding the event early in the year, perhaps at the end of the first quarter. If you want to showcase science fair and other student projects, make STEAM a culminating activity near the end of the school year. If you have a theme based on an upcoming science event, such as an eclipse or rocket launch, set the date around that. Check school, district, and general calendars to avoid holidays and competing events. If you are planning to have a telescope activity, consult your local astronomical society for a good day such as a full moon and book their telescope and expert. Allow plenty of prep time. Scheduling your event a week or so after a break provides some vacation time to work on stations.

Select an activity menu and solicit or order supplies. At a faculty meeting at least two months before your event, offer a list of suggested activities, such as the one attached, and briefly describe each one. Teachers are, of course, encouraged to come up with their own activities, but you will get more volunteers if the planning is done for them. The number of stations depends on the number of volunteers and the size of your event space. Count the number of tables in your cafeteria, add the activities that can be done on the floor and activities should be done just outside the cafeteria. This sets your maximum number of stations. Have teacher-volunteers sign up for their chosen activity. Ideally the activity should be appropriate to the teacher's grade level so the teacher can practice the activity with his or her own class. Have a variety of challenge levels from a toddler corner to robotics. But keep the activities simple as they should be fun, not frustrating, and possible to complete during a two hour time frame. Save complicated projects for the classroom and science clubs. STEAM Night is a time for quick explorations.

Once you know what activities will be offered, get as many donations as possible then order other needed supplies.

Recruit parent and community volunteers. To assist the teacher and keeps stations running smoothly, invite other adults to help. Send home a "save the date" notice a month in advance encouraging parents to contact their child's teacher to volunteer. Parents can work in half hour shifts and still enjoy other activities with their children. If you have a PTA or other parent group, recruit its members. Contact your local AAUW which often has retired teachers who make excellent volunteers. High schools may have students who need community service hours. Local churches and service clubs are other potential sources of extra hands.

Set up training sessions and make posters with instructions. Demonstrate to each volunteer how to do the selected activity. This could be done during collaboration time or even during lunch periods. A poster or tri-fold board for each activity should be made with the title, challenge, simple instructions and the science behind it. Make examples where appropriate.

Line up student helpers. Students love to be involved; make use of their help. Science club, service club, or PLUS students can make posters advertising the event. Create a set-up crew. Schedule students to work in shifts to pass out activity menus and take-home bags at the entrance and to assist at stations. Select students to demonstrate some cool science.

Plan student demonstrations and announcements. Half way through your event you may wish to freeze activities and make announcements. Welcome families and thank them for coming. Students can do some brief but impressive demonstrations such as a large elephant toothpaste eruption, counter-weight balancing tricks, and remote controlled robots. If it is early in the year, a few students can briefly describe their research and engineering projects. At the end of the year, awards can be given for successful projects. This is the time to showcase you school as the vibrant, forward thinking institution that it is.

You may also wish to hold a raffle. Each person entering STEAM Night will receive a raffle ticket with their bag and activity menu. Local stores may be willing to donate STEM toys. Foldscopes can be ordered inexpensively. Students can make slime kits at very low cost.

Advertise your event. A month in advance send home a save- the- date- notice. A week in advance, send home an invitation to families. Send the invitation home again a day before. Make sure STEAM Night is listed in any monthly or weekly parent letter and school calendar and is advertised on the school marquee. Students can make posters and put them up around the campus.

Make final preparations. The week before your STEAM Night, sketch a layout of you event showing the arrangement of tables and where each station will be located. Some activities may need to be located by electrical outlets; others need to be close to a water source and a few should be outside. Keep the footprint of the event reasonable compact while allowing enough space to work safely. You may wish to arrange your stations by difficulty level or by science concept (e.g. circuit city, chemistry, engineering events, math art etc.) Share the layout with your custodians so that tables are arranged properly. Your custodians need to plan ahead for some clean-up time after the event. Coordinate with your After-School Program director if the ASP uses the multipurpose room. Put each station's materials into large labeled boxes or plastic tub(s). Buy reusable bags, cheap, disposable plastic table clothes and gloves. Type up the STEAM Night menus, indicating the difficulty level of each activity. Prepare a map of activities.

Set Up. As soon as the multipurpose room is available after school, work with your custodian to set up tables in your desired layout. With student helpers, cover all tables with dollar store plastic tablecloths. Put down plastic table cloths or drop clothes around projects that will be messy such as slime and Eggbert. At the end of the evening, messes can be rolled up in the tablecloths and thrown away. Put up the poster or trifold board for each activity and set out the material boxes. Volunteers can set up the activities. Set up any projects or demonstrations on the stage and check that the microphone is working. Get ready to rock and roll.

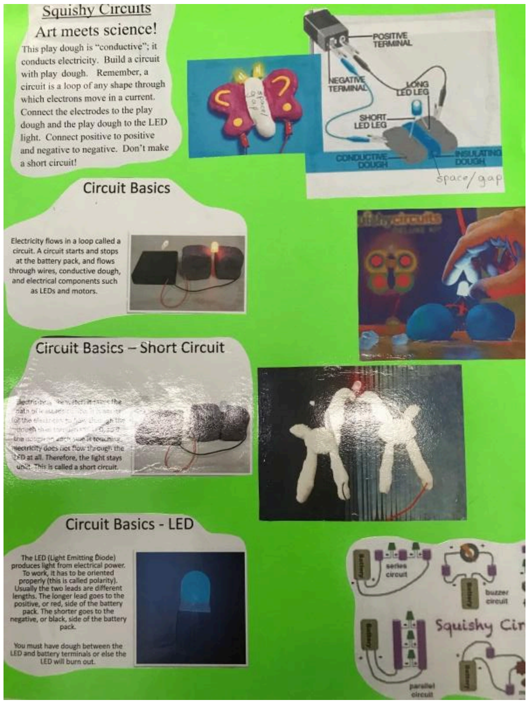
Suggested activities. Try to select something for everyone. Your county office of education may have kits that will work at your STEAM night and save you some prep and expense. Below is a list of other project at a variety of skill levels. A few families may elect to stick with one project the entire evening; that perseverance should be encouraged. Most families will desire to try a variety of project. Note that some projects need only standard school supplies, some require a trip to the grocery store, some use materials that must be ordered online, and a few require an initial investment in hardware you need only buy once. All materials for the projects listed below (with the exception of eggs and milk) are in our Makerspace/Exploratorium.

Science

<u>Circuit City</u>

- **Squishy circuit sculptures.** Participants make two small conductive playdough sculptures, connect them with an LED light, and wire them with the leads of a battery pack to create a work of art that lights up. More complex creations can be made by adding insulating playdough. See directions at http://courseweb.stthomas.edu/apthomas/SquishyCircuits/videos2.htm. Printable PDF directions at

http://courseweb.stthomas.edu/apthomas/SquishyCircuits/PDFs/Circuit%20Basics.pdf

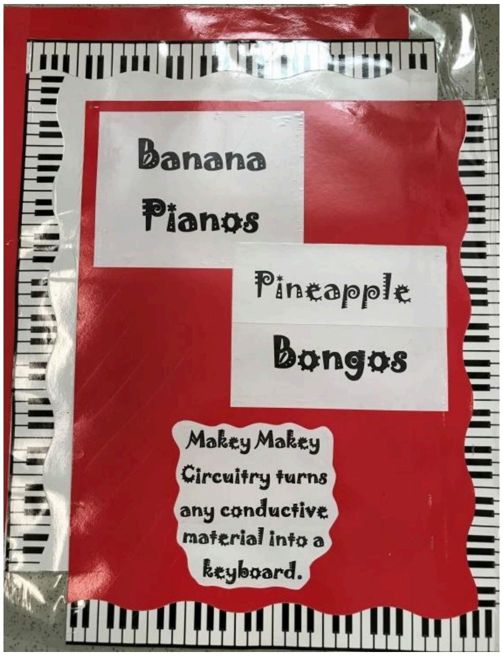


- **Light-up cards.** Participants create a greeting card or sign that uses copper tape as part of the design which acts as a circuit that lights up an LED sticker powered by a 2032 coin battery. The budget is 18 inches of copper tape, one LED sticker and one 2032 lithium coin battery plus paper or cardstock, markers and clips. Can also use cellophane and tissue paper if desired. To assist younger students, teacher can provide copies of pre-designed circuits from the Chibitronics website if desired. See https://chibitronics.com/simple-circuit-tutorial/ and **https://chibitronics.com/templates/**
- **Snap Circuits.** This requires investment in Snap Circuits, a great way to teach students about circuits and a former toy of the year. Snap Circuits can be purchased at

https://www.elenco.com/brand/snap-circuits/ or on Amazon at https://www.amazon.com/Snap-Circuits-SC-300-Electronics-Exploration/dp/B0000683A4

- **MakeyMakey Banana pianos, pineapple bongos, and Fruit Genie symphonies.** MakeyMakeys are a great investment that turns anything into a keyboard. Prewire several classroom computers and MakeyMakeys into banana pianos and a pineapple bongo for participants to play. Leave one or more MakeyMakey and some fruit for participants to wire to Google's Fruit Genie for enhanced musical performances. For pianos, open the site https://apps.makeymakey.com/piano/ on the computers; stick a MakeyMakey alligator clip into each of five bananas noting the arrow/ note correspondence, plug into the computer and play. For bongos, open https://apps.makeymakey.com/bongos/ and follow the same procedure. For those who desire to play fancy music but don't know how to play the piano, google has come up with the free Fruit Genie site, http://piano-genie.glitch.me/, which turns an 8 button controller into a full 88 key piano enhanced by AI. MakeyMakeys can be purchased on Amazon, https://www.amazon.ca/MaKey-Original-Invention-Kit-Everyone/dp/B008SFLEPE, or https://makeymakey.com/, which also has instructional videos. You can use an Arduino or raspberry pi in lieu of a MakeyMakey with Fruit Genie if you have those available, although the

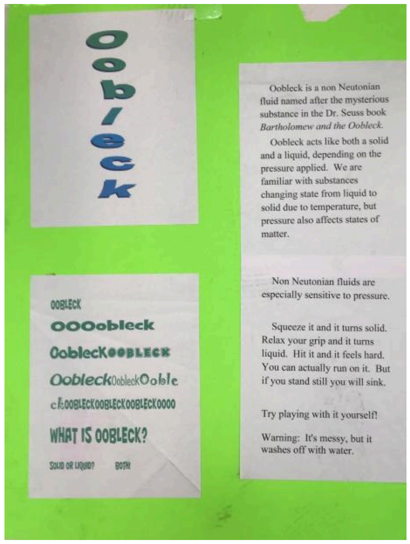
MakeyMakey alligator clips makes wiring easier for students.



Chemistry

- **Blowless Balloon Blow Up.** Save up recycled bottles for this activity. Challenge students to blow up a balloon without blowing. Using funnels, participants fill unused party balloons with baking soda, stopping just before the powder reaches the neck of the balloon. Students pour a couple of inches of vinegar into small recycled bottles. Working with a partner, carefully stretch the neck of the balloon over the top of the bottle while the body of the balloon hangs down, without letting any baking soda into the bottle. Once the balloon neck is securely over the top, lift up the balloon so the powder all falls in. A simple acid/base reaction creates CO2 which blows up the balloon.
- **Oobleck**. Whether you call it Oobleck or Gak, this activity is best done outside as it can bet messy. Participants put corn starch into a cup, gradually add water, stirring with a craft stick or plastic spoon until firm, then pour into their hands. Oobleck changes from a liquid to a

solid with pressure. Squeeze or slap it and it turns firm. Release the pressure and it turns into a liquid.

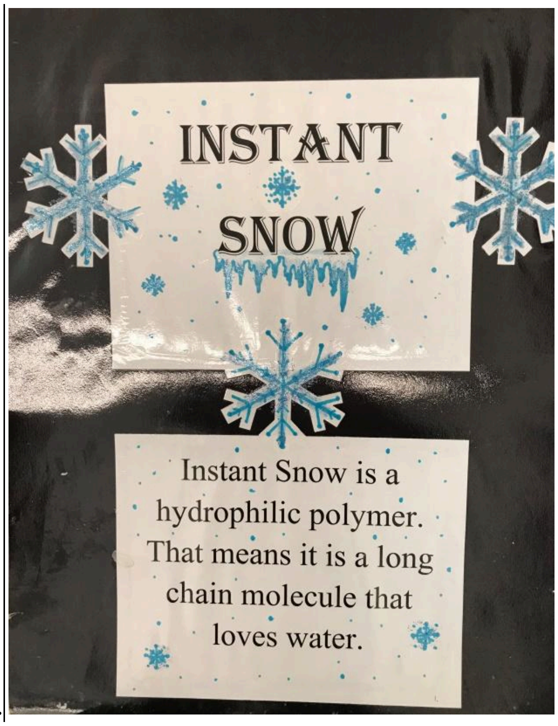


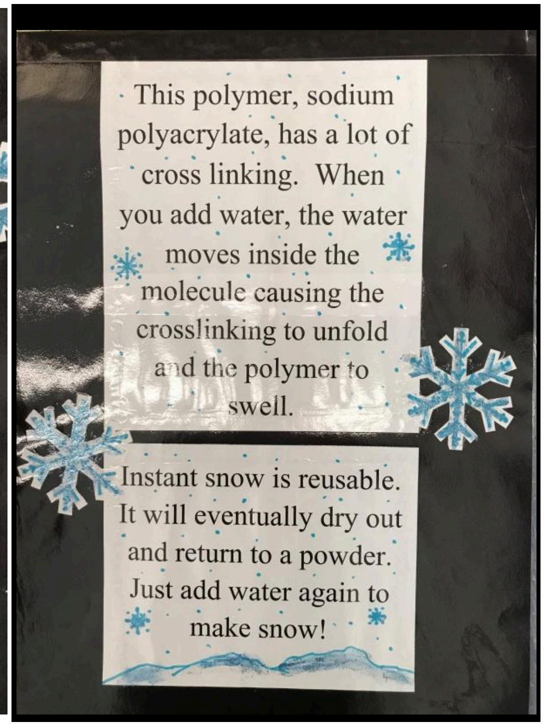
- **Bubbleology**.   This is another activity best done outside. Students use a variety of tools from around the house as bubble wands such as loops of yarn, slotted spoons, potato mashers, and coat hangers, as well as dollar store wands in various shapes. Then students design their own wand using materials such as wire, yarn, or chenille sticks. What shape of bubble can you blow? Can you blow a square bubble with a square wand? Does the shape of the wand matter? Who can blow the biggest bubble? What happens when two bubbles are attached? For background information on the math and science behind bubbles, as well as bubble solution recipes, see http://www.exploratorium.edu/ronh/bubbles/
- **Atomic Models.** Participants make cookie models of atoms then eat them. Provide a poster of the periodic table, large, strong, flat cookies, canned frosting, M&Ms, preferably in just two colors such as the breast cancer awareness M&Ms, sprinkles, plastic knives, and napkins. Students frost a cookie which represents the empty space that makes up the vast majority of an atom's size and is there solely as a background to build the model upon. Explain that it is impossible to build a model to scale as a M&M sized proton would make a scale model bigger than the whole school. Have students pick a small element from the first

full row of the periodic table such as carbon. Students find its atomic number and put that many M&Ms in the middle to represent the protons and distribute an equal number of sprinkles around the rest of the cookie to represent the electron cloud. Students then find the atomic weight of the element, subtract the atomic number from the atomic weight to determine the number of neutrons, and put that many of the other color of M&Ms in the nucleus. If the atomic weight has a decimal fraction in it, explain the weight is listed as a weight average of the various isotopes of that element.

Polymers – Kids will show up for a Slime-a-thon

- **Instant Snow.** This is the easiest activity possible. Volunteers put one scoop of instant snow, a hydrophilic polymer, into a clear plastic cup; students add water. Voila! Instant Snow can be purchased at Walmart, https://www.walmart.com/ip/Instant-Snow-by-Cra-Z-Art-Cra-z-jar/537742121, Steve Spangler, https://www.stevespanglerscience.com/store/instant-snow-powder.html, or Amazon, https://www.amazon.com/Be-Amazing-Insta-Snow-Makes-Gallons/dp/B000FA6APE. Prices vary greatly so comparison shop carefully, paying attention to weight or amount made

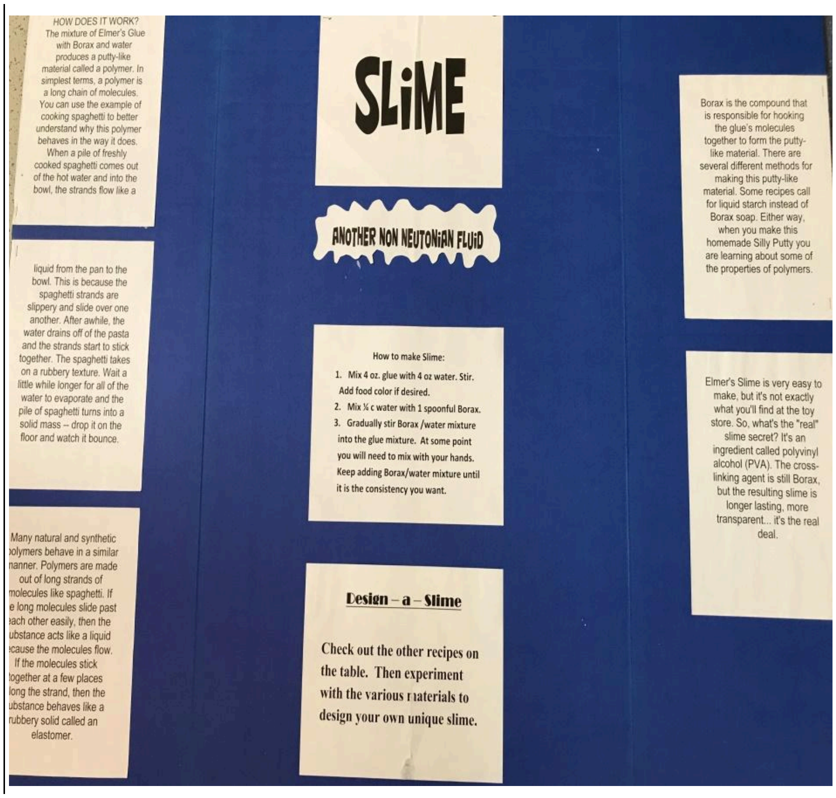




- **Design-a-Slime.** To give students an opportunity to experiment and be creative, provide clear plastic cups, craft sticks, food server gloves, both clear and white school glue, buckets of water/Borax solution (1/2 cup Borax in 1 gallon water), measuring spoons and measuring cups, bottles of shaving cream, food coloring, glitter and other enhancements. Provide a basic slime recipe but ask students to observe what happens if less/more borax solution is added. What, if anything, will happen if a little baking soda is sprinkled in? What will happen if straight borax powder is added? What will happen if shaving cream is added? See https://www.thoughtco.com/monomers-and-polymers-intro-608928 for simple background on polymers.

Basic slime recipe: Mix 1 teaspoon of borax in 1 cup of water. Stir until the borax is dissolved. In a separate container, mix 1/2 cup (4 oz.) white glue with 1/2 cup water. Add food coloring, if desired.

Gradually stir in borax solution. Knead the slime. To keep procedures simple on STEAM Night, the diluting water can be skipped and only the borax solution used.



The force is with you

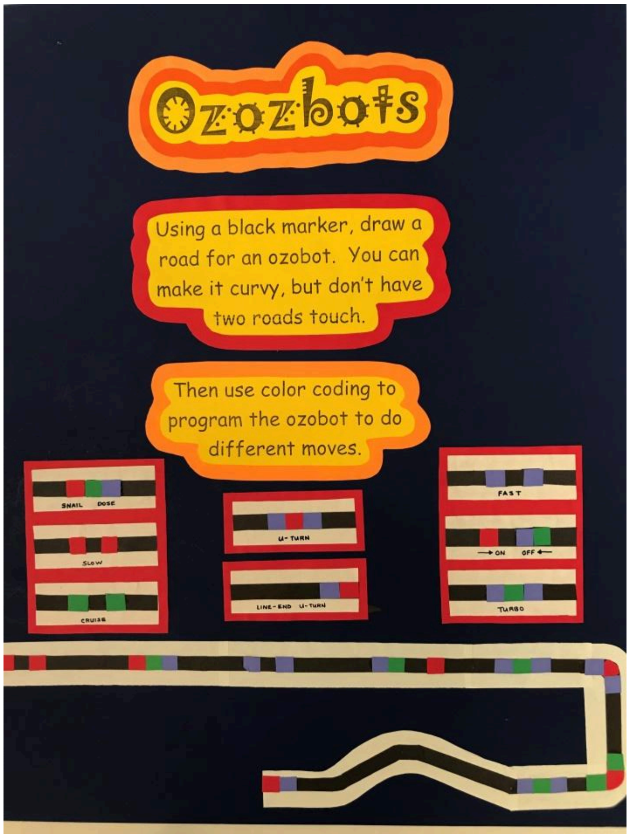
- **Magnet Exploration.** Provide a variety of magnets and materials to explore magnetism. This would include pencils and ring magnets to float magnets, a steel legged chair on the table with magnets on one side of the legs and paper clips tied with thread on the other to float paper clips, iron filings in small plastic boxes as well as in jars of water or oil, compasses, small toy cars or trucks with magnets in them and bar magnets to do non-contact pushing and pulling, a cardboard box with a hidden magnet inside that mysteriously moves objects on the outside, pairs of color coded magnets for students to experience the push and pull of the magnetic force, small tubs with different materials such as wood, paper, plastic, brass, aluminum and finally iron based objects such as steel spoons and paper clips to test what magnets will pull on.

- **Physics Exploration.** Students can explore gravity using marble mazes, ramps and cars which they can arrange and rearrange. Add a stop watch and measuring tape so students can compare the relationship between angle and distance. Students can construct roller coasters out of marbles, tape, and foam tube pipe insulation available at Home Depot.

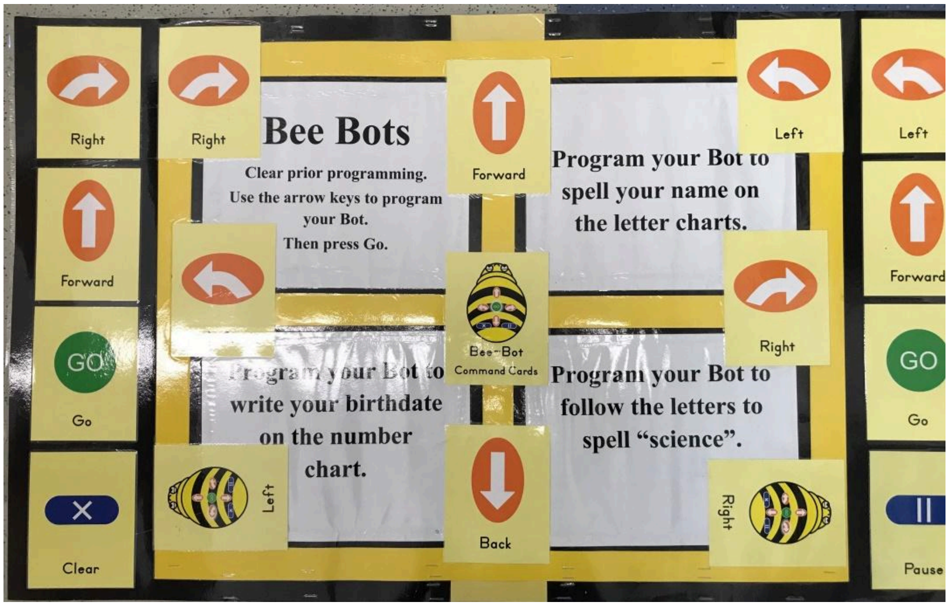
To explore contact forces participants create chain reactions using dominos, tubes, ping pong balls, and so forth. Lakeshore has some kits if you wish to save time. Finish this table off with a Newton's Cradle.

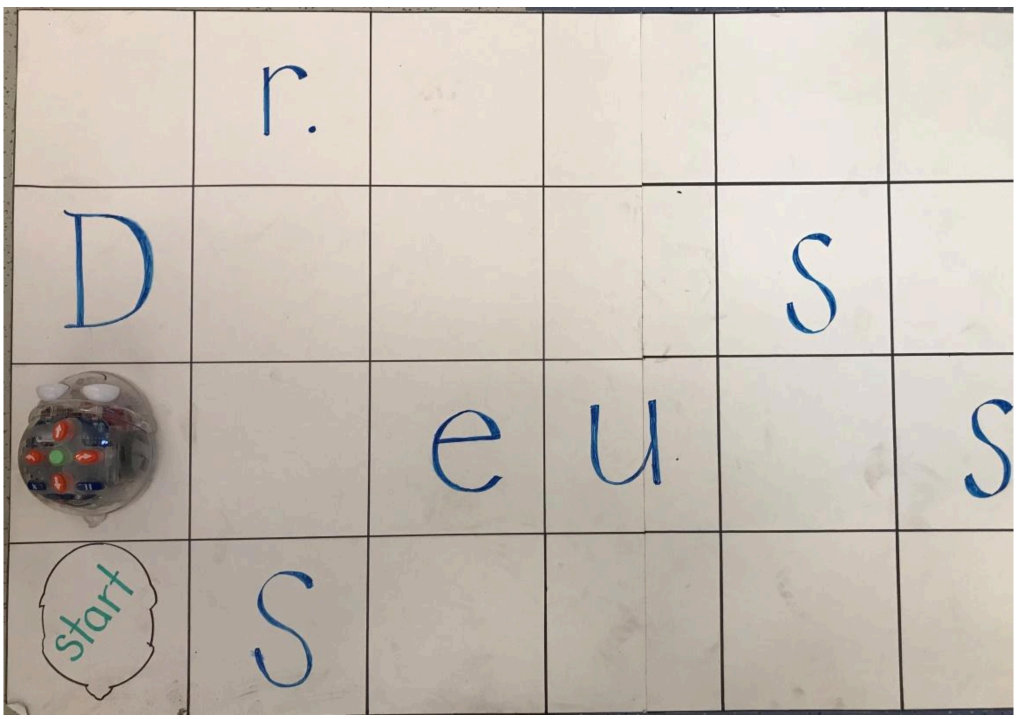
Technology – Offline Coding

- **Ozobots.** These adorable little robots let students experience the concept of coding as they draw color coded paths to control the actions of the bots. Ozobots can be purchased at https://ozobot.com/stem-education or on Amazon at https://www.amazon.com/Ozobot-Bit-Extra-Bot-Black/dp/B00ZYUND00



- **Bee-Bots and Blue-Bots.** Students can "write" code using the directional arrow cards then program the robots directly on their backs using directional arrow buttons or with block coding on an iPad with a LOGO app. For STEAM Night, use bulletin board paper to make large grids consisting of 6 inch squares. Write the letters for "science", or similar words, scattered across the grid. Participants must program their bot to follow the path made by the letters to spell the target word. Even parents get addicted to this challenge. These bots can be purchased at https://www.terrapinlogo.com/beebot.html or on Amazon at https://www.amazon.com/Bee-Bot-Rechargeable-Robot/dp/B0141I3RBU.





- **Binary code.** Students write their name in binary code then make a keychain with their initials in binary code with black beads for zeros and white beads for ones. See attachments, and see:

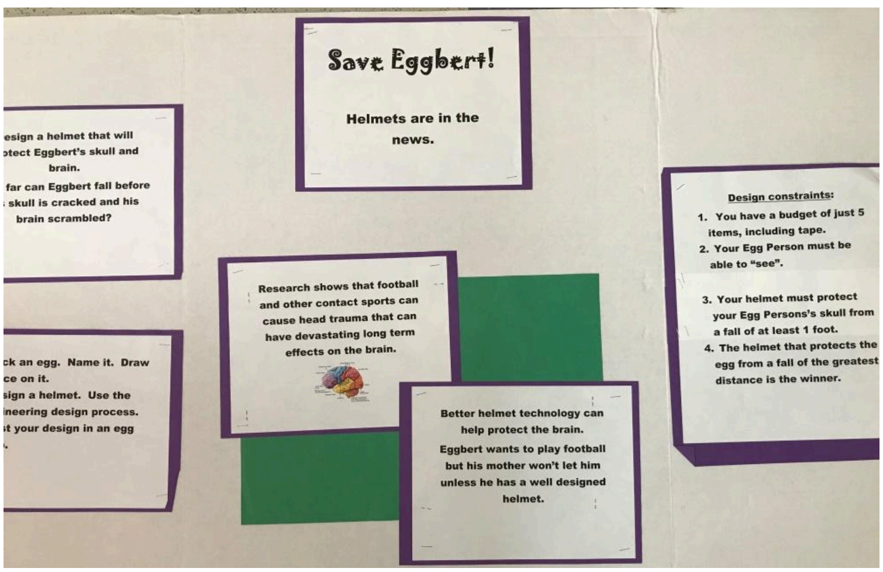
  https://www.ssww.com/blog/steam-activity-for-kids-create-a-binary-code-keychain/binary-code-system1-png/;

  https://www.google.com/search?q=binary+code+worksheet+pdf&rlz=1C1CHFX_enUS501US501&tb

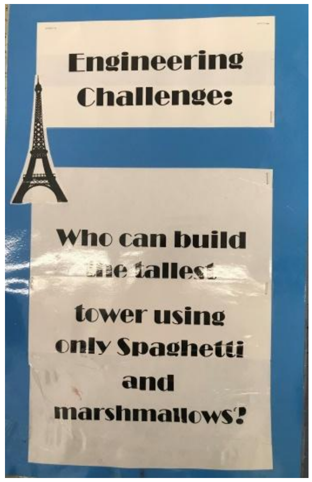
m=isch&source=iu&ictx=1&fir=5TKaAMwyQivwKM%253A%252Cd_3H1715xKfI9M%252C_&vet=1&usg=AI4_-kSRoB-WW1UHsTaeKPSwyCaZC4oTOg&sa=X&ved=2ahUKEwil9b

Engineering

- **Eggbert Needs a Better Helmet.** Students use the engineering design process in this update of the classic egg drop, this time with an NFL slant. Provide flats of eggs, markers for drawing Eggbert's face on the egg, scissors, yardsticks and measuring tapes, and a variety of materials for designing a football helmet such as strips of cardboard and bubble wrap, cotton balls, tissue, tiny erasers, balls of rubber cement, chewing gum, cardstock strips, tape strips, pieces of foam or foam stickers, and newspaper . Put down a plastic tablecloth in case Eggbert doesn't survive. The criterion: must survive a fall from at least three feet (or the height of the trifold board). The design constraints: can only use four pieces of materials including tape, can't cover Eggbert's eyes. The designer of the helmet that protects the egg from the highest height is declared the winner.



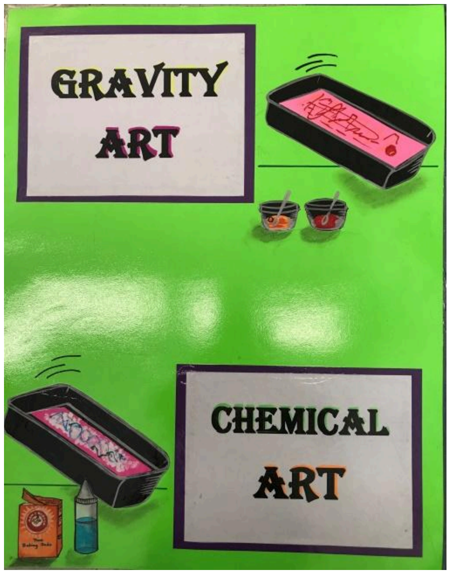
- **Tower Challenge.** Who can build the tallest, self-supporting tower out of only spaghetti and marshmallows? There are many variations to this challenge. Cards, chenille sticks (aka pipe cleaners) or three pieces of paper and tape can substitute for the spaghetti and marshmallows. Balancing a plastic egg on top can be an additional criterion that greatly increases the challenge.



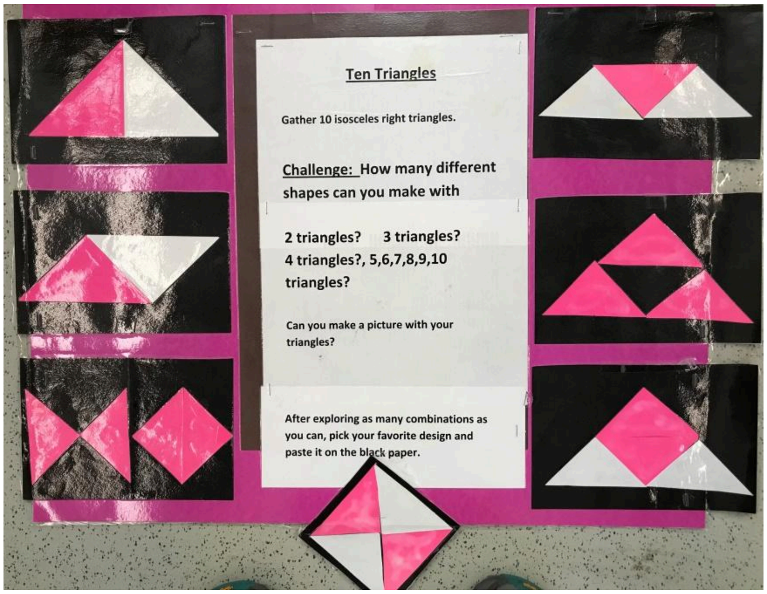
- **Future Engineers' Playground.** For the toddlers and preschoolers in the crowd, cordon off a corner with benches for resting parents and fill it with blocks, Brio, Duplo bricks, Magna-Tiles, or other construction toys.

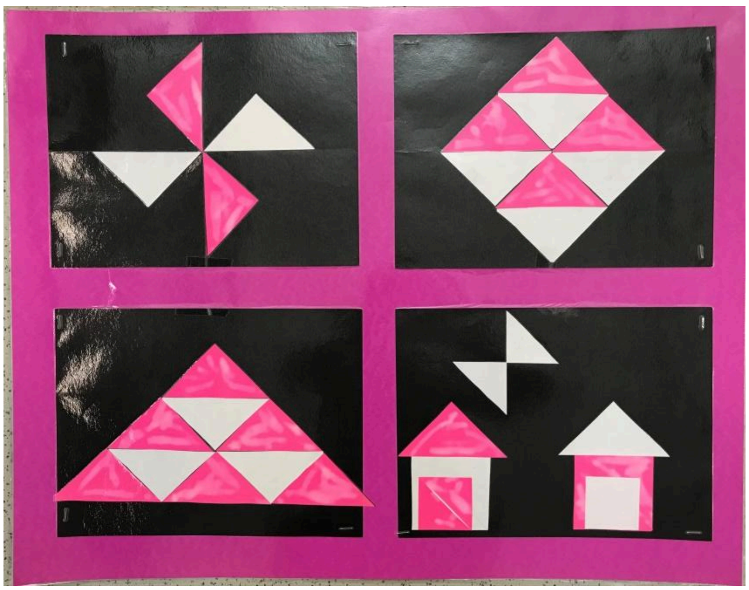
Math and Science Art

- **Chemical Art.** Participants create an ephemeral work of bubbling modern art by squeezing vinegar dyed with food coloring out of mustard/ketchup bottles (available at Smart and Final) onto a thin layer of baking soda in baking pans. Volunteers dispose of used baking soda and put in a new layer.

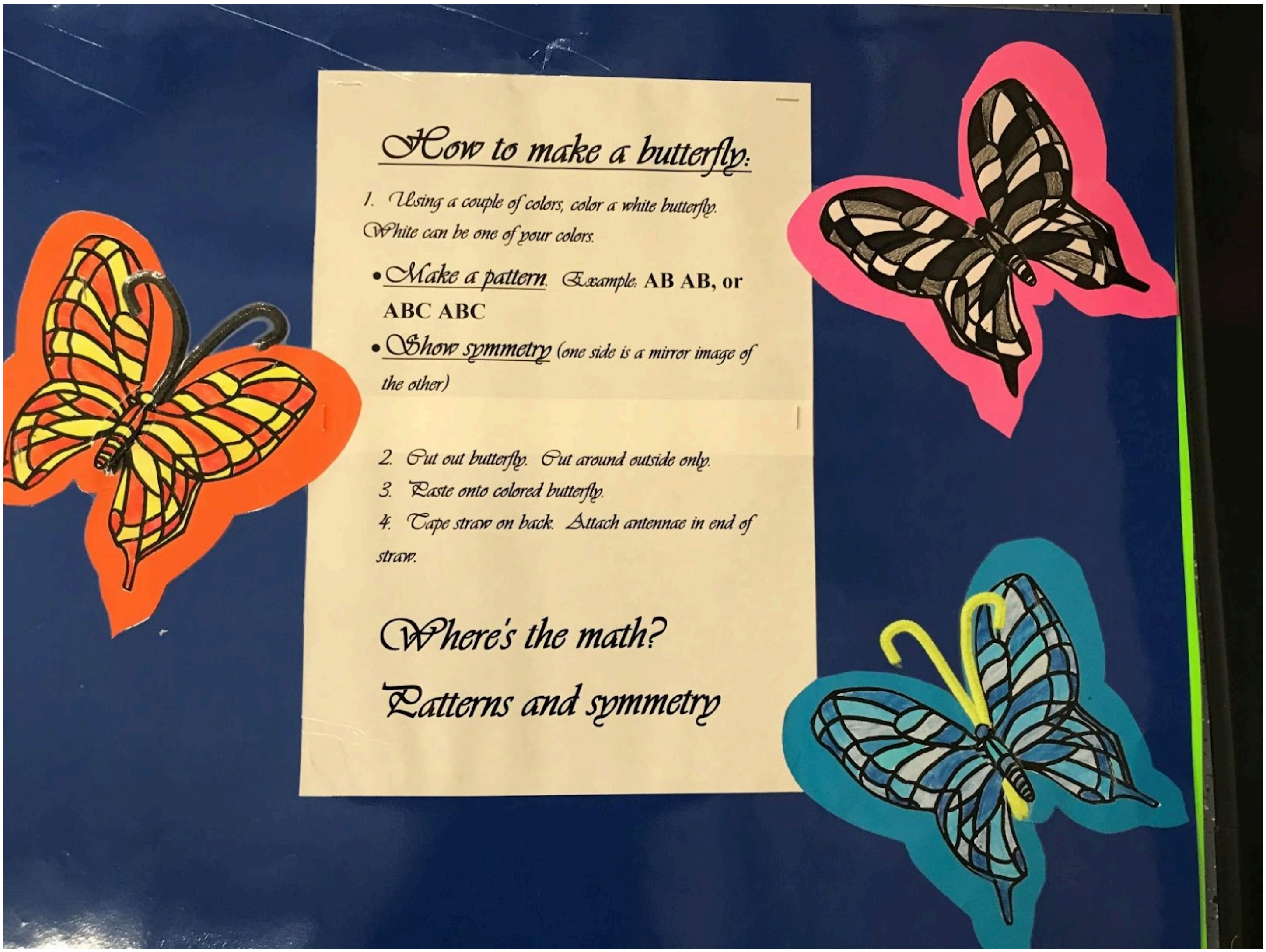


- **Gravity Art.** This modern art participants get to take home in their bag. Put a piece of construction paper on the bottom of an aluminum baking pan. Using a plastic spoon, students scoop a marble out of a small container of tempera paint, drop it in the pan, then tip the pan to roll it around. After replacing the marble into the container it came from, students scoop out a different marble from another color. If students get too carried away and put too much paint on their paper, they can make a print of their painting by placing another piece of paper on it, pressing down and rubbing lightly, then carefully peeling the two paintings apart.
- **Ten Triangles.** Using hot pink and white isosceles right triangles on black construction paper, students explore making shapes out of shapes. What shapes can you make out of two triangles? Three triangles? Four, five, six, etc. triangles? After exploring, students choose their favorite design and paste it on the black paper. No matter what they come up with the results are stunning due to the high contrasting colors. An alternative to Ten Triangles is tangrams. See attached patterns.

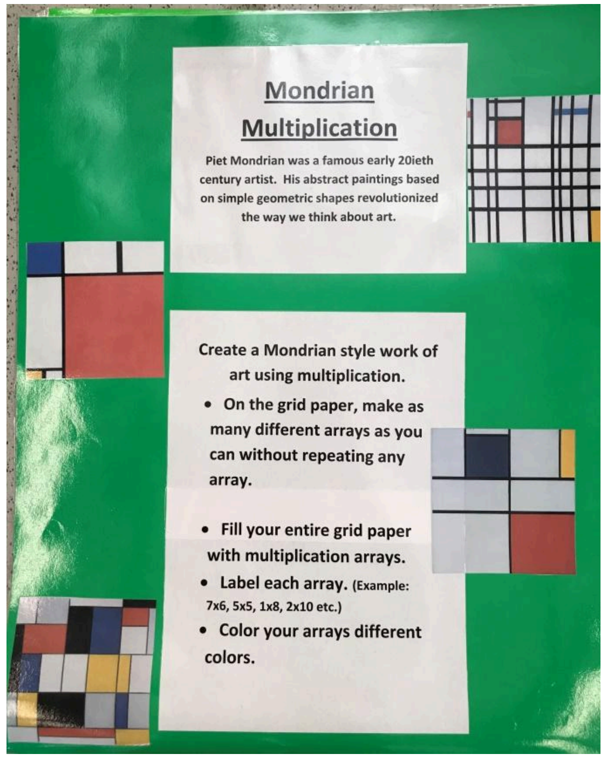




- **Butterfly Art**. Students make patterns and show symmetry as they create beautiful butterflies. Please see attached patterns. The inner butterfly, which students color with markers, should be copied on white paper. The outer butterfly should be copied on a variety of ultra-bright colors. After coloring, cutting, and pasting, students tape a flex straw on the back, insert a chenille stick folded into antennae into the straw, and fly the butterfly home.



- **Life Cycle Art**. To accompany their butterfly, students can make a book about insect metamorphosis that magically unfolds into an artwork that illustrates the butterfly lifecycle. Please see attached patterns and example. See also, the frog lifecycle sequencing art.



- **Mondrian Multiplication**. Using markers in a variety of colors, students are challenged to cover a hundred grid with as many arrays as possible without ever repeating an array (eg, 2X4, 2X6, 1X10, 3X3 etc.). This takes planning and is harder than it sounds but the result can be beautiful. Students should sketch out and label their arrays in pencil first, making adjustments as needed, before coloring in each array with markers. Tip: start with larger arrays then fill in with smaller arrays, saving the 1Xs for last to fill in.

- **Fraction flowers**. Copy circle fractions onto ultra-bright paper. Students create a garden of flowers by cutting, layering, and pasting the fractions.

Multicultural Math Games

Parents and children can work together to solve games such as Magic Squares, Shonga Networks, and Tower of Hanoi, or compete against each other in Hex, Three Men Morris, Game Sticks, or Nim. All these games are from *Math Around the World* by Beverly Braxton, Philip Gonsalves, Linda Lipner, and Jacqueline Barber, published by Lawrence Hall of Science as part of their GEMS (Great Explorations of Math and Science series.) ISBN 0-924886-43-9. To order go to http://lhsgems.org/GEM407.html.

Coding for Kindergarteners? Absolutely!

By Maridee Stanley

America is short on good computer programmers. Currently, tech companies are recruiting programmers from India, not by choice, but by necessity. Don't we want our own students to get these high paying tech jobs so we can finally break generational poverty? This can happen if we start our students coding early. How early? High school? Middle school? Intermediate grades? Kindergarten is not too soon. For the past 8 years, my kinders at Kennedy Elementary have successfully learned the basics of block programming and began to think of themselves as the programmers and tech entrepreneurs of the future. Students have fun and the parents love it!

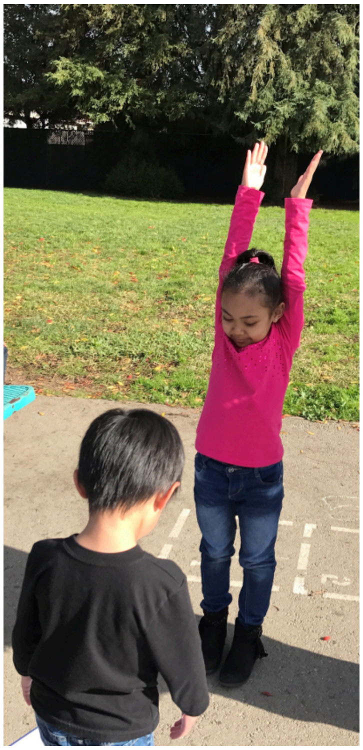
"But, you ask, " I'm not a programmer. How can I teach coding?" Don't worry. Coding isn't as hard as you think. If I can do it, anyone can do it. Trust me on this. All the instructional work is done for us by Code.org, Tynker, PLTW, or Google, and the beginning lessons are designed for pre-readers. Why wouldn't any teacher want to do this?

You have several options to get your students started on coding. The best-known is Code.org, the developer of the Hour of Code. If your school has Project Lead the Way, you have the PLTW computer science module. Tynker has some free content at https://www.tynker.com/free-classroom-school/coding-curriculum?&filter=block-coding, or you can sign up fora free teacher account for an easy K lesson at https://www.tynker.com/school/#/join/teacher. Google will send teachers a free kit to be used with their online material. See:: https://csfirst.withgoogle.com/en/home

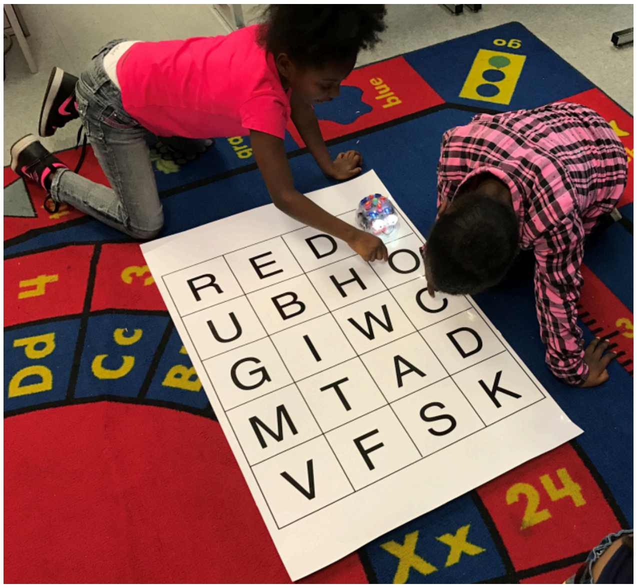
Even if you supplement with other programs, Code.org is indispensable as it has the most resources. Go to https://code.org for their easy-to-navigate website. From there, you can watch videos, go to the student courses (Course A for age 4-7 https://studio.code.org/s/coursea-2018), visit the educator section and create your account (https://studio.code.org/courses?view=teacher), peruse lesson plans such as https://curriculum.code.org/csf-18/coursea/3/ or print out offline material (eg: https://code.org/curriculum/course1/6/Activity6-RealLifeAlgorithms.pdf). If you and your colleagues want an enjoyable Saturday, attend a Code.org Computer Science Fundamentals PD, learn some tricks, and pick up some swag. See https://code.org/professional-development-workshops to locate workshops. Or, take the online PD at https://studio.code.org/s/K5-OnlinePD .

If you don't have time for all this, simply take your class straight to an Hour of Code classic, Angry Birds, and start coding at https://curriculum.code.org/csf-18/coursea/3/

I recommend starting offline. I use Code.org's "Move It" for PE, and PLTW as a center activity. Ozobots are a popular way to teach the concept of programming. But my students' favorite offline activity is the BeeBot, a small robot that is programmed with directional arrows on its back

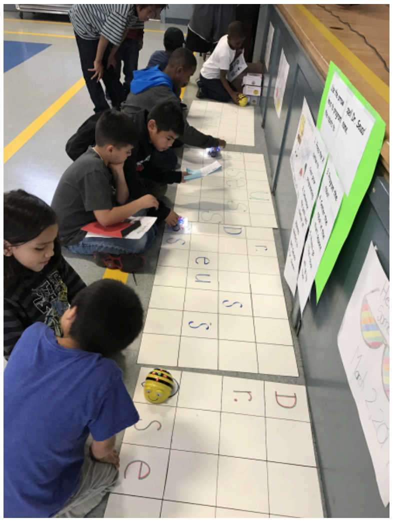


Kinders doing Code.org offline coding for P.E. Tip: Don't try this on a windy day.

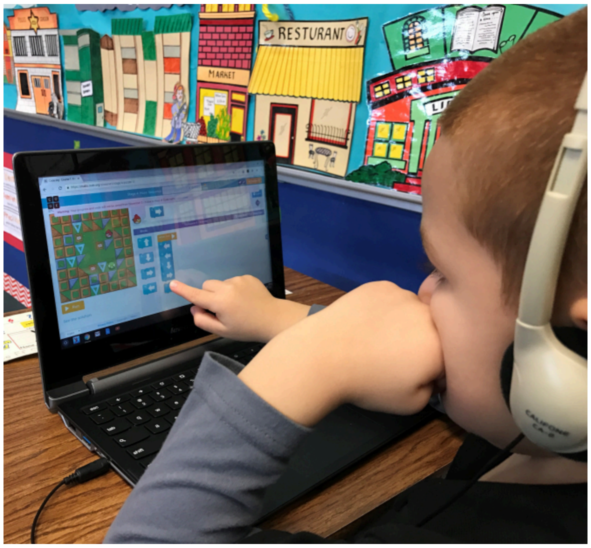


Using the directional cards that come with BeeBots and BlueBots, kindergarteners write a line of code.

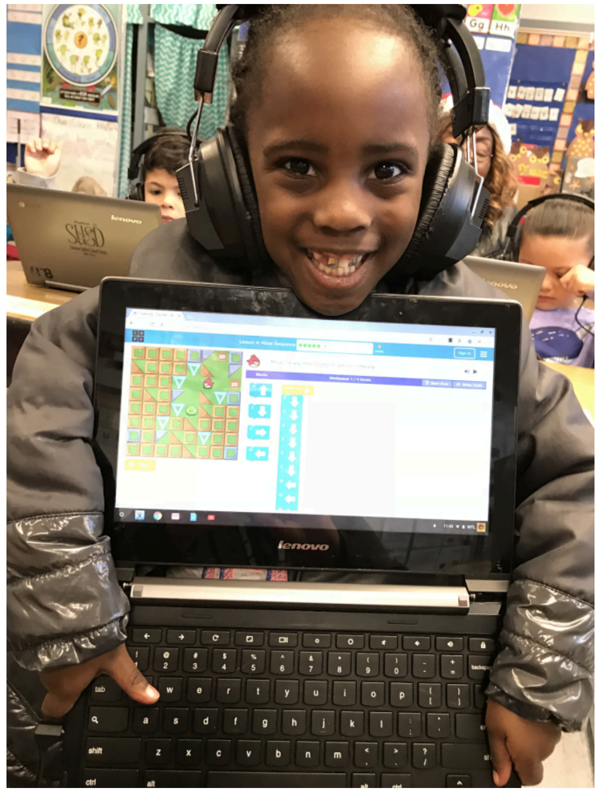
Using direction keys, students program BeeBots and BlueBots to spell CVC words or order numbers.



BeeBot and BlueBot programming was a big hit at STEAM Night and Literacy Night at Kennedy. Even some parents got hooked.

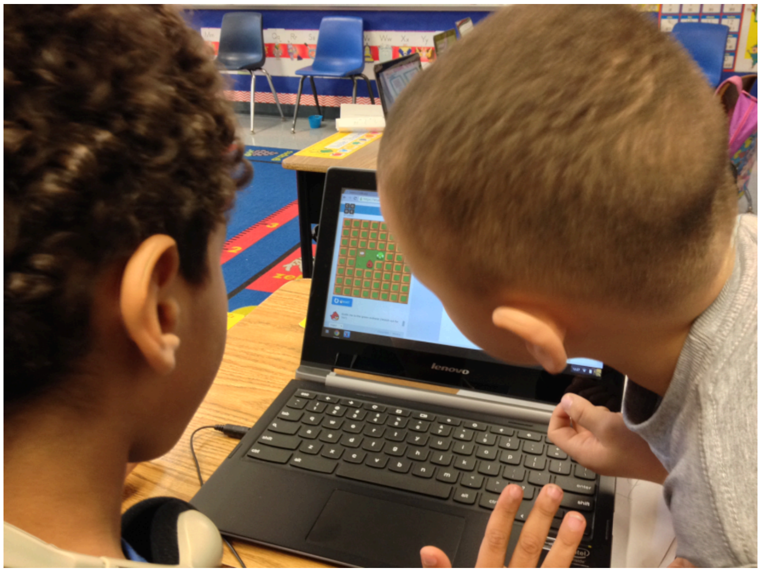


Engaged in coding.



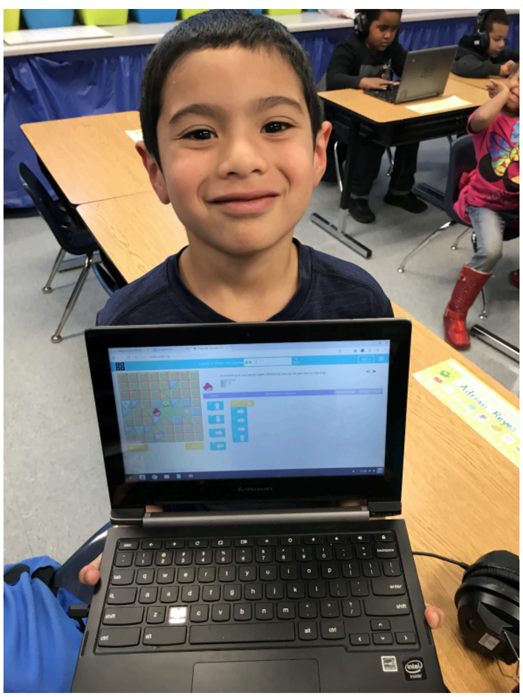
Proud of her first lines of code.

Kindergartener showing off her lines of code.



Students help each other on an Angry Bird coding exercise.

After the offline warm-ups, students should do Code.org’s Course A, followed by Angry Birds and Minecraft on Hour of Code. Some may progress on to Star Wars or Moana, although you may have to tell students the objective ...get scrap metal in Star Was and fish in Moana. I don’t recommend Frozen for kinders as this requires knowledge of angles. Many kinders begin to have difficulty when they get to loops, but with patience, persistence, and careful counting, they can overcome difficulties. Remind students that “fail” means **f**irst **a**ttempt **i**n **l**earning something awesome.



“Look, Ma, I’m programming!”

Coding a Minecraft game is a good incentive to finish ST Math and is an alternative for students who have completed work early.

If you have never coded, try some super-simple kindergarten block coding on the following Google Doodle celebrating 50 years of children's coding.
[Celebrating 50 years of Kids Coding Doodle]

And please, get your students coding. You might inspire the next Bill Gates or Mark Zuckerberg.