

# How to start a STEM club

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**A** STEM club gives students opportunities to engage in stimulating hands-on activities in a setting that is not driven by state content standards, grade-level grouping, or standardized tests. This article describes the steps (and challenges) involved with implementing an after-school STEM career club that links hands-on activities to college majors and future careers. The overall goal of the club is to increase the likelihood that participating students will pursue a STEM career. We also wanted to increase students' and teach-

ers' STEM content knowledge and skills. Our middle schools don't allow lunchtime clubs because they want to make sure students take the time to eat. Because there are multiple lunch periods, some kids can't attend if the club is only offered during one period.

## Step 1: Make the commitment

The first step involves finding teachers who are interested in running the clubs and asking your administrators for support. Administrators need to commit a space for the STEM club meetings, address any logistical concerns (e.g., buses and snacks), and supply some funds for materials (and possibly stipends for teachers who lead the clubs; our teachers were compensated \$60 per two-hour club meeting they led). The best club leaders are teachers who volunteer, are passionate about the club, are willing to switch from a "teacher" into a "club leader," are committed to learning about the activities, and are willing to plan sufficiently for the clubs. They may not always be

STEM teachers; some of our club leaders taught Spanish and social studies, for example.

Even for small clubs, at least three teachers should make the commitment. Two can run the club while the other person can step in if one of the other the teachers is absent. We had an average of 40 students in each of our clubs (at four middle schools), which were led by six teachers at each school (24 total). Often one to two teachers could not attend club meetings due to other obligations, so it was important that all STEM club teachers receive professional development. In our teacher professional development sessions on Saturdays, teachers practiced three club meeting activities that included relevant safety training (i.e., when safety goggles or gloves are necessary, teaching outdoors, and handling potentially dangerous materials).

## Step 2: Plan activities

Initially, we planned one stand-alone activity at a time for our club meetings. After the first semester,

### Safety

Safety for students was emphasized in each professional development meeting. Teachers were taught how to properly handle and control lab equipment and specimens and shown how to direct students to do so as well. Teachers were instructed on when to use safety goggles and gloves, both of which were provided for the club meetings [as needed].

we started to plan theme-based activities that would span three meetings. In year 2, for example, we focused on climate change and climate-related careers for meetings four, five, and six. (See sidebar on p. 92 for an example of an activity where students designed a soundproof room.) Focusing on themes helped us streamline our planning.

All activities were funded through an NSF ITEST grant and will be supported now with funds from a private foundation. We assembled a book of all of the activities used in the STEM clubs, then gave it to our participating teachers, who are planning the next year based on these or other activities of their choice.

### Formative assessment

After the first year, we decided to have specific learning goals for each club meeting’s activities. At the end of each club meeting, students now answer approximately five multiple-choice questions about the club and provide feedback about that club’s skills or content (see Online Supplemental Materials). We also invited students to provide feedback about the club meetings. This helped us learn how we were doing and what we might need to address in future clubs.

### Step 3: Logistics

Our club met for two hours every other week, on the same day each week. We started each meeting with a snack because students

are hungry after school. To create a relaxed environment, we limited the number of students in each classroom to 15, using multiple classrooms along one hallway. But the club can also meet in a media center or a central meeting room. If the school has strict rules on which classrooms can be used for the club, the larger setting may allow for more students to participate. Providing buses to take students home following the meeting gave all students the option to participate in the club.

### Funding

Although we had grant funding to start our STEM clubs, there are other options to help support the clubs beyond the local Parent Teachers Association or the school. When seeking funding for supplies, transportation, or teacher stipends, the following websites may be useful: Fund My Classroom, DonorsChoose, GoFundMe, AdoptaClassroom, and ClassWish (see Resources). Parents or guardians could also be asked to pay a small fee for their student to participate in the club.

### Step 4: Recruit students

A month before our first meeting, recruitment posters (Figure 2; Online Supplemental Materials) were posted in the hallways and in-class announcements were used to promote our club. Additionally, schools found success promoting their STEM club through open houses at the be-

#### CONTENT AREA

Varies depending on club focus (science, technology, engineering, and/or mathematics)

#### GRADE LEVEL

6–8

#### BIG IDEA/UNIT

Career and college awareness

#### ESSENTIAL PRE-EXISTING KNOWLEDGE

None

#### TIME REQUIRED

Two hours after school

#### COST

Varies depending on activity

#### SAFETY

Varies depending on the activity

ginning of the school year. Interested students signed up with one of the club teachers, who sent home information about the club to parents (see Online Supplemental Materials). The information included all the planned meeting dates and times, and it

**FIGURE 1: STEM career club activities**

Club activities				
Year 1	Year 2		Year 3	
Spring 2015	Fall 2015	Spring 2016	Fall 2016	Spring 2017
1. Forensics and the human skeleton	1. Save the penguin	7. Heart basics	1. Makey Makey	7. Disease and pandemics
2. Alka Seltzer rockets	2. Bottle rockets	8. Health of the heart	2. Scratch programming	8. Natural selection and evolution
3. Detoxifying chemical waste	3. eMammal	9. Respiratory system	3. Makey Makey and Scratch	9. Physiology and biomathematics
4. Rubberband dragster [part 1]	4. Weather and climate	10. Design a cell phone	4. Introduction to Raspberry Pi	10. STEMulating roaches: output
5. Rubberband dragster [part 2]	5. Role of carbon dioxide	11. Soundproof room	5. Raspberry Pi and LED lights	11. STEMulating roaches: input
6. DNA and paper chromatography	6. Alternative energy	12. Game design	6. Raspberry Pi and GPIOs	12. STEM spectacular: end of year 3 celebration
7. End of year 1 celebration		13. Science of making ice cream: end of year 2 celebration		

asked parents for their consent and whether their child would need a ride home. Students were not recruited based on any specific characteristics, nor were there any limits on the number of students who could participate. The only requirement to participate was a signed consent form; there was also an optional photo release.

### Student relationships

Most students like to work in groups, but some may feel left out if they are not selected to be in a

group by their peers. During the program, we let students move to different groups to create a positive experience for them. Teachers made sure, however, to remind students that all members should be included in the activity, and for some activities, students were assigned to groups.

### Step 5: Plan for the clubs

Once students have submitted their forms, arrange the bus transportation, and estimate how many supplies you need for the clubs (see Resources). We initially used

existing activities that we found, but we also revised and developed new ones for club meetings. Some of the activities shown in Figure 1 are available on our wiki (see Resources).

Sometimes busy teachers were not prepared for the club meetings. That's why we created a preparation checklist (Figure 3) to help them prepare. In addition, we asked teachers to meet for one hour a few days before the club for a pre-club planning session. Many teachers used this time to coach other teachers on the content or skills for the club meeting,

and all teachers used the time to get organized.

Teachers found it helpful to work through all of the activities to figure out how long they took and to review any relevant content. We had the luxury of providing paid professional development for teachers who participated in the club, but one teacher could also prepare the others during an after-school or in-school planning meeting.

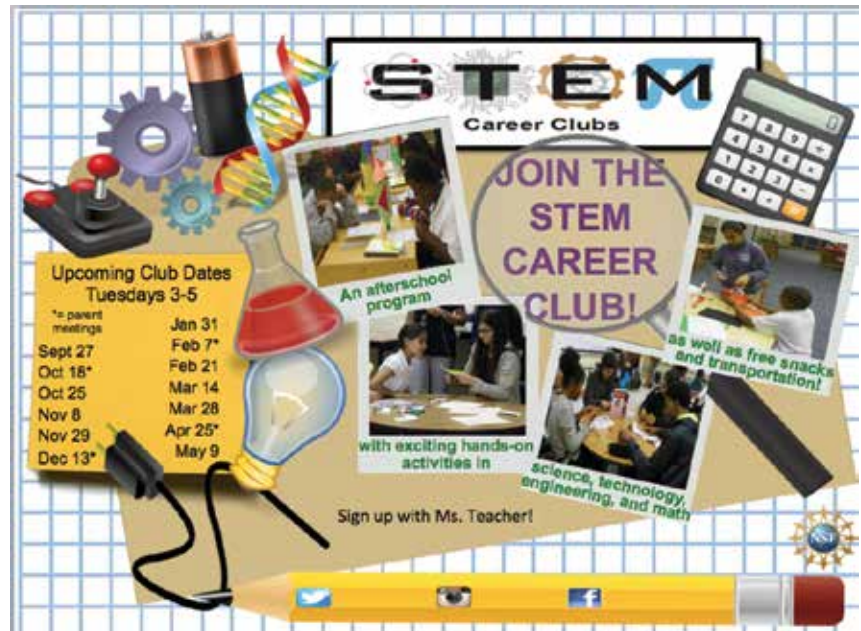
### Teacher relationships and demeanor

Working together in a STEM club can be difficult for teachers in terms of personalities and leadership roles. The pre-club meeting time and assigned teacher roles helped with this. Some clubs had one leader, while others rotated leadership based on the content. Anticipate disagreements when working closely together at the end of a school day and realize that compromises will need to be made. Considering that it can be hard to switch from the role of teacher to club leader, we recommended being flexible with the noise level and when students get off task. Remember that this is a social learning experience. Try to step back from being “in control.”

### Step 6: Invite parents

Parents were supportive of the STEM career club and wanted to help. To make parents feel more connected with the clubs, we sent home STEM club newsletters after each club meeting. The

**FIGURE 2:** A recruitment poster



STEM club newsletters included student reflection articles about club meetings, STEM content and vocabulary, STEM careers, and upcoming club meeting dates and parent meeting dates. Our club held parent meetings twice a semester after the clubs to discuss topics such as educational pathways to college and financial aid options. Parents can also be invited to come in and serve as judges for designs or help groups as they build models and carry out experiments. (Note: At most schools, parents will need to pass a volunteer clearance. This should be addressed at the beginning of the year, perhaps when students are being recruited at the parent-teacher open house.) Teachers also can send home activities that students could sign up to do with their parents at home (see Online Supplemental Materials).

### Step 7: Invite STEM professionals

While students gained exposure to STEM careers and professionals via videos from the STEM Career Awareness Wiki (see Resources), we also wanted to connect them with STEM college majors and professionals. We recruited STEM professionals from the same geographic area or professionals who were first generation, minority, or female. We found that students seemed to respond well to college students and young speakers. Whether they visited in person or via Skype or Google hangouts, students enjoyed hearing about what the speakers were like as middle school students. In 5–7 minutes, speakers talked about their life, professional pathway, and career and spent the rest of

## Example club activity: Creating a soundproof room (5E model)

### Learning Goals:

- Understand the properties of waves and the wavelike property of energy in earthquakes and light and sound waves.
- Compare the properties of waves to the wavelike property of energy in earthquakes and light and sound.

### Safety:

- Scissors should be handled carefully.

**Engage:** Students watched three video clips (total of 10 minutes) on:

- how sounds works and how to make a soundproof room in your home,
- a comedic example of what music producers do to make an artist sound good, and
- the movement of sound waves and their structure and properties [see Resources for video links].

**Explore:** Students then created their own soundproof room that would be tested using an iPod and decibel meter app. Student materials included a Chinese take-out box and their choice of three of the following materials: cotton balls, foam sheets, cloth, tongue depressors, felt, and bubble wrap. Glue or tape could be used to bind the soundproof room materials into a structure less than 8" x 8" x 8" [20 x 20 x 20 cm]. The iPod was placed inside the take-out box base of the soundproof room and the decibel meter was placed 6 in. [15 cm] away from the box. Once assembled, each team tested their design in front of the club members to see whose room best muffled the music played on the iPod.

**Explain:** Before testing, students explained why they thought their materials would muffle the sound. Students would then observe which designs worked best and which did not. After all groups tested their designs, the teacher leaders probed students with questions regarding why some designs functioned better than others and reviewed concepts about how sound works.

**Elaborate:** In groups, students reflected about which of the soundproof rooms performed best and worst and how they did in relation to other students. They analyzed which parts of their designs worked well and which did not. Students were asked how they would change their design if allowed to complete the activity again and why they would approach the task in that way. If there was additional time, students could test their proposed changes and compete again.

**Evaluate:** Students completed five relevant content questions for evaluation of STEM content.

### Guiding questions for post-activity reflection with students

1. What things did you and your team consider as you were trying to decide how to make the best soundproof room?
2. Describe the characteristics [e.g., materials, placement, shape] of the optimal sound booth design.
3. What was the most challenging part of the design process in your activity today? Why did you find it challenging?
4. Did your design fail at any point during the design process? What did you learn from this "failure?"
5. What is *iteration* and why is this important in the work of product designers?

the time (approximately 10 minutes) fielding student questions (see Figure 4 for guest speaker guidelines).

## Step 8: Celebrate your success

At the end of each of our clubs, we invited students and parents to an ice cream social with some relaxed activities and music. Students received certificates for participation, and we created some extra awards for things such as “Tech Savvy” and “Engineering Guru.” Some of our clubs designed T-shirts and raised funds with local businesses to buy them for all of the students. Most of our students reported feeling a sense of comfort and belonging as members of the STEM clubs and some reported that it gave them an alternative since they were not in sports.

## Conclusion

The STEM career club gives students a sense of belonging, allows them to build friendships, gain exposure to stimulating activities, learn new content and skills, and find out what they are passionate about. Career exploration helps students learn more about the education required for a career, details about the career, and what they like and don't like about it. We hope that this article will help you plan and be prepared for the challenges of starting a new club. ●

### FIGURE 3: Sample checklist from the soundproof room meeting

#### Needed preparation

Snack is purchased and ready at the beginning of club. [When students sign up for the club, teachers can request that students or parents fill out a sheet that would allow them to address any dietary restrictions.]

#### All students watch career videos (10 minutes)

“Trailer: Essentials of Audio Engineering With Young Guru”

<https://youtu.be/bvwRBRhq2RI> [1:16]

“Sound Engineer’s Hard Work” [humorous] [1:18]

[https://youtu.be/G2Rhh\\_4GZmU](https://youtu.be/G2Rhh_4GZmU)

“DIY \$23 Mini Sound Booth Building in Under an Hour”

<https://youtu.be/UTeUeRxAS7M> [5:38]

#### Students will be designing their soundproof rooms.

Before the club: Have graph or scratch paper for students to draw and brainstorm on. You could have a Chinese take-out box as an example of the structure and explain to them the materials they will be able to use. The box should be no larger than 7 x 7 x 7 in.

#### Students will begin building their soundproof rooms.

Before the club: You will need to have all the materials ready for the club meeting.

For each group of two to four students prepare:

- one Chinese take-out box,
- one pair of scissors, and
- one roll of tape.

For each class of 15–20 students, prepare:

- two bags of cotton balls,
- one large roll of bubble wrap,
- one platform built by the teacher,
- two sets of construction paper,
- two rolls of paper towels/tissues,
- one roll of aluminum foil,
- four packs of Styrofoam sheets,
- four packs of felt sheets, and
- any other similar materials students may use to build their soundproof room.



**FIGURE 4: Guidelines for guest speakers**

Good afternoon potential guest speaker,

I just wanted to contact you regarding the opportunity for outreach in our STEM club. We would love for anyone on your team to speak with our clubs regarding their STEM career in \_\_\_\_\_ [e.g., web design, development, or other related field]. We are specifically trying to find women and speakers of color, if possible, to talk with our students. However, we would be grateful for anyone who is inspiring and motivational in your field.

We are looking for speakers on the following dates and times (enter dates below):

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These are the guidelines for our guest speakers. Speakers are asked to share for 5–10 minutes and then take questions for 5–10 minutes. [Talk no longer than 10 minutes total because students usually have a lot of questions!] If the speaker can visit the school in person, it would be great if they could hang out and talk informally with students as they complete their activities for the day before and after their talk. If an in-person visit is not possible, we can arrange a virtual visit through Google Hangouts or Skype.

Things speakers may want to share include:

- your current job duties and previous jobs,
- average salary someone in your field would start out making and retire making,
- a description of your field,
- your background (what were you like as a middle school student),
- how you prepared in middle and high school for college and your career,
- suggestions on things that they may do now to prepare for your career,
- the types of college courses that you took and how they prepared you for your job,
- anything else that may encourage and enlighten students about your field, and
- try to make your presentation as engaging as possible by bringing in items from your work or involving students in your presentation.

Please let me know if anyone on your team would be willing to speak with our middle school STEM Club students!

Thank you for your help,  
Teacher Club Leader

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**RESOURCES**

AdoptAClassroom—[www.adoptaclassroom.org](http://www.adoptaclassroom.org)  
 ClassWish—[www.classwish.org](http://www.classwish.org)  
 DonorsChoose—[www.donorschoose.org](http://www.donorschoose.org)  
 Fund My Classroom—[www.fundmyclassroom.com](http://www.fundmyclassroom.com)  
 GoFundMe—[www.gofundme.com](http://www.gofundme.com)  
 STEM activities—<https://stemcareerawareness.wikispaces.com/Teacher+Resources>, <http://bit.ly/2wCGxgA>  
 STEM career videos—<https://stemcareerawareness.wikispaces.com/VIDEO+LIST>  
 Video links—<https://stemcareerawareness.wikispaces.com/Student+Resources>

**ONLINE SUPPLEMENTAL MATERIALS**

Parent information sheet, sign-up sheet, student certificate, multiple-choice questions/feedback sheet, recruitment poster—[www.nsta.org/scope1711](http://www.nsta.org/scope1711)

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