TABLE OF CONTENTS

1. Note from the Authors
2. Importance of Engineering in K-12 Education
3. The Role of a STOMPer
   a. The STOMP Model
   b. Job Description
   c. Expectations
   d. Limitations of the STOMP Position
4. Classroom Content
   a. Grade Appropriate Content
   b. Appealing to a Wide Range of Students
5. Classroom Tips and Techniques
   a. Classroom Culture
   b. Lesson Organization
6. Resources
   a. Online
   b. People
   c. Found and Craft Materials
   d. Educational Technologies
NOTE FROM THE AUTHORS

This manual is designed as a resource for Tufts University students that have been selected to become mentors in the Student Teacher Outreach Mentorship Program (STOMP).

STOMP was founded in 2001 years ago by just 5 fellows in 2 classrooms. Since then it has grown exponentially to include over 60 fellows and 30 classrooms. STOMP was originally created as a response to new Massachusetts educational frameworks mandating engineering be taught in all public schools. STOMP aimed to train teachers to lead their own engineering lessons in their classrooms. The training was executed in three phases. In the first phase, STOMPers would run engineering lessons (much the same way that they do now). In the second phase, the teacher would take more of a leadership role and ran his or her own engineering lessons, while the STOMP fellows provided classroom assistance and technical support. In the final phase the teachers would be able to run the lessons completely on their own.

Since the program’s modest beginnings, it has grown and changed in such a way that the STOMP fellows take more of a leadership role. The three-phase model was found to be unsustainable—teachers truly value the university students’ presence, and the university students enjoy long-standing mentoring relationships with teachers. Now, STOMP’s mission is to improve K-8 education through engineering with a strong partnership between educators and university students. Through this classroom collaboration, K-8 students engage in meaningful engineering work with positive STEM role models while educators learn technical skills. University students gain first hand education experience, as well as engineering enrichment as they must truly master technical concepts in order to teach them effectively.

Compiled by researchers and employees at the Tufts University Center for Engineering Educational Outreach (CEEO) as well as the executive board of STOMP, this manual includes advice based on the authors’ extensive outreach experiences.

We hope that this manual is a valuable resource in your experience as a mentor in the Student Teacher Outreach Mentorship Program!

Thank you,

Members of Tufts University’s Center for Engineering Educational Outreach and the STOMP Executive Board 2014-2015
THE IMPORTANCE OF ENGINEERING IN K-12 EDUCATION

Engineering exists at the baseline of our daily lives. Products ranging from computer chips to helicopters to cereal are all designed, manufactured, and packaged by engineers. Introducing engineering in the classroom helps enhance children’s natural curiosity and empower them to understand and change the world around them in a positive way. Engineering education is important for students to develop creative problem solving, risk-taking in the classroom, and social skills.

Our philosophy behind engineering education is based on the belief that students can make their own decisions and solve their own problems. In practice, it’s a “kids can” mentality! Students are given a problem and they must use their critical thinking skills to determine an appropriate and feasible solution. The STOMPer guides the student through the challenges they face along the way. STOMPers encourage students to use the Engineering Design Process, which teaches students to change, test and improve frequently.

As the students test frequently, they will experience a number of failures. From each failure, the students gain important information which they can use to improve their project. Students learn that failure is valuable, a lesson that can be applied to the rest of life. As students come to accept failure, they become more willing to fail and, therefore, more willing to take risks.

Most academic grading systems in today’s elementary schools are based on completion and correctness. The students are given higher marks if they answer more questions correctly. In engineering activities, the emphasis is placed on the thinking, process, and sensible end product. No one “correct answer” exists--it is up to the student to develop the best solution to the problem.

Furthermore, integrating engineering activities into the classroom gives students opportunities to work in teams, so that they practice social skills. As a team, students have to compromise on one solution to the problem. They must delegate tasks so that they complete the project on time. As they work on separate aspects of a single project they need to communicate often and effectively. Students who are able to cooperate with others will be more successful in their future work, both academic and non-academic.
The Role of a STOMP Fellow

Successfully integrating engineering in K-12 curriculum requires additional time, effort, and flexibility from the teacher. Teachers are generally unfamiliar with engineering, and may be intimidated or unsure about teaching engineering. In addition, teachers are under pressure by the school system to abide by rigorous curriculum standards. These factors inhibit K-12 integration of engineering and explain why many students graduate high school without any conception of the engineering discipline.

That’s where STOMP comes in.

The Tufts University Student Teacher Outreach Mentorship Program (STOMP) pairs college students with K-12 teachers to assist in the integration of engineering in the school curriculum. The STOMPers enhance the engineering knowledge of both the teacher and children by preparing and leading hands-on lessons.

We also want to make sure that our time in the classroom reflects the CEEO’s beliefs about children. We believe kids can do amazing things: invent, explore, solve problems, and change the world.

The STOMP Model

The STOMP fellows are put into pairs at the beginning of each semester. The pairings are made based on levels of experience—new hires are always paired with veteran STOMPers—and logistics—scheduling, car availability, etc. Each pair is then assigned a teacher, classroom and time slot.

Once paired with a teacher, STOMPers must develop a working relationship with him or her. All members of the STOMP-teacher team uphold a responsibility to contribute their respective expertise to the program. STOMPers provide their wealth of engineering skills and materials. The responsibilities of the teacher are to help the STOMPers become familiar with working in a classroom setting and to relate the STOMP material to other classroom material. The STOMP model is mutually beneficial. The teachers become familiar with engineering, while the fellows gain an awareness of the education system, along with enhanced communication and leadership skills.

STOMPers, with the help of the classroom teacher, design and teach an innovative engineering curriculum. It consists of 8-10 weekly sessions, each an hour long. The curricula have overarching themes, and culminate in a final project.
**STOMPER Job Responsibilities**

The position of STOMP fellow is a weekly commitment of about 5 hours. Executive board members and highly involved STOMP fellows can expect to log closer to 10 hours.

Over the course of the semester, STOMP fellows are required to:

**Attend Wednesday meetings.** Meetings are during open block. STOMP must take priority over other clubs or organization meetings, since it is your job. You are expected to actively participate and engage in meetings. This means not texting or browsing the Internet during a meeting. Attendance and engagement are crucial to your growth as a STOMPer. Failure to attend and participate in meetings consistently is grounds for dismissal.

**Attend relevant trainings.** STOMP offers a number of trainings in educational technologies and teaching skills that you may use in your classroom.

**Design and submit a unit outline with your partner.** The unit should be submitted at the beginning of the semester and then updated each STOMP day, after your lesson. It is expected that the unit be cohesive, well-informed, and written to the best of your ability.

**Meet with your teacher and observe your classroom before you teach your first lesson.** See “Interacting with School Personnel” for more details.

**Contribute activities, feedback and comments to the STOMP website.** If the website stays current, it will be a valuable resource for all fellows to learn from each other’s experiences in the classroom.

**Prepare for each lesson.** Lesson preparation is key to success in the classroom. It may mean preparing worksheets or PowerPoints, gathering materials, preparing demonstrations, making copies and/or meeting with your partner.

**Clean up after each lesson.** If you use CCEO materials, you must bring back the materials (or their remnants) to the CCEO and put them neatly in their correct place.

**Communicate with your classroom teacher.** Prior to your first lesson, you should meet with your teacher about classroom norms, logistics and the curriculum (see the STOMP website for more details). Over the course of the semester, check in each week with the teacher, either briefly during class, over the phone, or via email. Ask him/her how s/he thinks the curriculum is going. Keep him/her up to date on your plans for the semester. Email him/her a lesson plan each week before your STOMP period.

**Attend your scheduled class period.** You will teach 8-10 classes during the semester. Each is 1 hour long. You are expected to attend and be on time to every class. In the case of a conflict, such as an exam or illness, you must notify your partner and Jess as soon as possible (at least 24 hours in advance). See below for a more detailed list of classroom expectations.
Complete 4 hours of sorting. Regardless of what materials you use in the classroom, you must help sort NXT kits, EV3 kits, WeDo kits and Snap Circuits. The hours are paid and are logged as all other STOMP hours. They may be completed on your own time as long as the CEEO is open (approximately 9-5 weekdays).

Log your own hours weekly. Fellows are responsible for logging their own hours of work. They must be submitted online each week no later than Sunday night. It is expected that all STOMPers log honestly.

Classroom Expectations

In the classroom, you represent STOMP, Tufts University and all engineers. As such, you should strive to be a positive presence at your school in the following ways:

Dress Appropriately. Your clothing choices may be the first thing the school staff, your teacher and your students notice about you. Be sure that the clothes you wear demonstrate that you care about STOMP and that you respect the classroom. Avoid ripped or dirty clothes, provocative clothes (including short shorts), sweatpants, pajamas, sports clothes or t-shirts with inappropriate logos. Students will notice your clothing choices. As a general rule, if you are questioning whether a piece of clothing would be acceptable in a school setting – it’s not.

Use Appropriate Language. Your language in the classroom should be free of vulgarity. Avoid discussing your personal life or content that is inappropriate for a classroom. If students ask you overly personal questions, remind them that that’s not classroom appropriate. Also consider the ages of your students. Avoid talking down to your students and using sarcasm with young students. For whichever grade you work with, you should strive to use respectful and accepting language with your students.

Be Prepared. Your students and teacher are depending on you to come into their classroom on the planned schedule. Regularly arriving late to the classroom or failing to show up on expected dates will seriously strain the relationship that you are developing with your students. If an emergency occurs that will make you late or prevent you from making it into the classroom, you should contact both your teacher (i.e. emailing them and calling the school office) and your STOMP executive board member or the program manager to inform them of this schedule change. Besides making it to your scheduled classroom visits, failing to prepare adequately for the classroom (i.e. planning activities, bringing in promised materials) will show a lack of respect for the class and make the experience less enjoyable for you and for the students.

Respect School Staff. Making a connection with school support staff and administrators can help you to feel more comfortable in your assigned school, and the school to be supportive of STOMP. Be friendly at all times. During one of your first school visits, introduce yourself to a school administrator. You should deliver a letter to him/her that explains how STOMP works and what you will be doing in which classroom. You should also introduce yourself to the front desk staff. Ask them any questions you may have regarding school policies. (i.e. Where can I park/lock my bike? Where would be a good place to unload equipment? What is the protocol for checking in/out? What forms do I need to fill out?)
**Limitations of the STOMPPer Position**

The working relationships developed with the school staff and co-teacher help to make STOMP successful and rewarding for everyone. As part of this working relationship, you should also be aware of the limitations of STOMP.

While you are leading a lesson, the teacher should remain in the classroom. You should never be in a classroom where a school representative is not readily accessible.

Furthermore, you are not a science teacher. If your classroom teacher asks you to teach a curriculum that does not align with the STOMP philosophy, please explain to the teacher how STOMP works. If s/he insists, let your program manager know about the situation immediately so that s/he can follow up with the teacher.

If you are ever put in a situation where you feel uncomfortable, please speak with your program manager, or the STOMP Executive Board members.
IN THE CLASSROOM

First Class Period
The first class can be the hardest. Make sure you do the following things before diving into your curriculum:

Introduce yourself. The students are always curious about guests that come into their classroom. You can share where you are from, what you study and maybe a fun hobby. If the students know a little bit more about you, they may feel more connected to you or more comfortable around you.
- Also, have the students introduce themselves. Learn the students’ names and use them! It may seem like a waste of time, but learning and using students’ names makes them feel valued.

Explain the concept of engineering. It's a good idea to gauge their understanding of engineering – what it is, who does it, what kind of jobs use engineering, where are examples in daily life. All of these are good questions to ask the students. The amount of detail you go into depends on the focus of your unit.

Set ground rules. Take the time at the beginning of the unit to set these rules, it will give you a “common language” to use throughout the unit. The ground rules should cover: working in teams, respecting each other, the materials, and the STOMPers, staying focused and being positive. One good exercise is to ask the students to complete the sentence, “Good engineers...” or “We are engineers who...” For example “Good engineers listen to their partners’ ideas.” Ask the students to be specific whenever possible. Terms like “respect” mean different things to different people (and different things in different situations). If a student volunteers a norm like “be respectful,” push and ask what behaviors show respect --- can you give me an example? What does that look like? Write the rules on the board or on a large piece of paper that you can leave in the room. If the teacher already has a document like this hanging up, use that, and remind them that normal classroom rules still apply.

Introduce the engineering design process. This is somewhat optional, as some units use it more explicitly than others. Again, the level of detail that you go into depends on the focus of your curriculum.

Anticipate issues that may arise. For instance, you may want to discuss “cheating” and whether it is a problem if students build off their peers’ ideas

When Addressing the Group
Have strategies to get students’ attention. Depending on the age group, it may help to have one or a few different ways to call the students to attention. It is good to be consistent with the younger kids, but with older students the routines can get stale, especially over the course of many weeks. Different “calls to attention” include: “Clap once if you can hear me,” flickering the lights, asking students to put their hands in the air and wave them like they just don’t care… etc.

Model the tone and volume that you ask of the group. For example, don’t loudly tell them to be quiet. It raises the energy in the room. Similarly, sitting at the front (opposed to standing over them) can soften the vibe.
When you speak to the group, make sure that everyone is focused. “Wait them out” if you need to. If you talk over someone, the implication is that you didn’t actually need his or her attention. Silence also encourages silence. Before you speak, try to minimize distractions. For example, ask them to put their LEGO's physically to the side.

Generate questions. Ask “what questions do you have” opposed to “do you have any questions.” Or, during project sharing, ask for one positive comment and one thing for improvement.

Check for understanding. When checking for understanding, make every student have to do something. For example, Thumbs up, thumbs down, or thumbs sideways.

Give instructions in a few different ways. Writing, drawing, or verbal. Students process information in different ways.

Keep it fun!

Classroom Content
One of the biggest challenges for all STOMPers, and especially new STOMPers, is creating a curriculum that is an appropriate challenge for a particular grade level and for the various students within that grade-level.

Responding to Students Who Need Help
We want students to work through problems themselves, but some problems are more meaningful than others. Facilitating a student-centered space requires balance.

- Don’t hesitate to help students with technical issues. When a student runs into a problem, consider the educational (and emotional) benefit of having the student solve the problem his or herself. If the solution to the technical problem is something that would be very difficult for students to figure out (e.g. a connection between two beams) it is fine to step in and tell the student how to fix it or fix it yourself.

- If students struggle with content (ideas, building, etc.), ask them to explain their process (so far) and their thinking. Often, verbalizing helps students become “un-stuck.”

- Encourage students to help one another. We want to create an environment in students work collaboratively and value each other’s “expertise.”

- If students are struggling with partner or group dynamics, do what you can to help the students work through the issue. This may be talking to all individuals or pulling the student to the side to get their impression of what is happening.

- It is sometimes difficult for children to find the balance between productive frustration and overwhelming frustration. We want children to solve problems on their own, but if you see someone
become so frustrated they are unable to move forward, give them a little more guidance than you usually would.

**Giving and Eliciting Feedback**
Encourage feedback that is KIND, SPECIFIC, and HELPFUL.

For example, say “Wow! The way you designed that structure is really sturdy! You did an awesome job connecting pieces together so your tower doesn’t fall over.” or “Oh man, see how these pieces move when you touch them, like this? Maybe you should figure out a way to make that sturdier!”

Don’t say: “This is a good tower!” or “You should improve this.”

Especially when students are successful, ask them to reflect on the process and their challenges. Ask leading, specific questions like:

“What did you have difficulties with?”
“Is there anything you modified along the way?”
“What made you think of that?”

**Grade Appropriate Content**
For your students to be engaged, it is important that your curriculum be grade-level appropriate. Your teacher is a great resource to help you make sure your curriculum is suitable.

In *Table 3*, you’ll find a general profile of students in 1st, 3rd, 5th, and 7th grade. Note that these are generalities, and your students may act very differently than the students described below. Most school systems have some variation in grade topics (i.e. circuitry may be taught in 3rd grade at one school and 5th grade in another). For more information, see the book “Yardsticks,” found at the CEEO.

**Table 3: Grade Profiles**

<table>
<thead>
<tr>
<th>Age</th>
<th>Academics</th>
<th>Social/Cognitive Development:</th>
<th>Productive Teaching Techniques</th>
</tr>
</thead>
</table>
| 1st Grade 6-7 | * First formal classroom  
* Basic reading (simple patterns, short books)  
* Basic writing (0 – 1 sentences, inventive spelling)  
* Addition & subtraction (single digits) | * Lecture attention span (5 -10 minutes)  
* Eager to please teacher  
* Eager to explain observations  
* Unrealistic understanding of abilities  
* Difficulty planning multi-step process  
* Difficulty seeing parts of a project.  
* Difficulty working with partners | * Activities containing very specific, clear expectations.  
* Activities with small, discrete goals.  
* Questions with direct answers, versus open-ended answers.  
* Opportunities to show off work.  
* Access to fewer different types of pieces. |
| 3rd Grade  | * Reading (beginning)  
* Lecture attention span (10-15) |  | * Activities contain clear |
| Grade 8-9 | Reading (long chapter books)  
* Writing (paragraphs, short book reports, formal spelling)  
* Addition/subtraction (triple digits)  
* Multiplication & division (single digits) | Minutes)  
* Focus on academic purpose  
* Teacher easily given respect and authority  
* Developing internal/external motivations  
* Eager to show abilities  
* Able to plan multi-step process  
* Beginnings of productive/distracting social groups |  
* Opportunities to explain thinking and ideas.  
* Questions answered by whole class versus by specific person.  
* Some questions open-ended.  
* Opportunities to show off project during various phases of the activity.  
* Recognition of particular strength in building or programming. |
| --- | --- | --- |
| Grade 5th 10-11 | Reading (long chapter books)  
* Writing (scripted book reports, scripted science reports)  
* Multiplication/division (double or triple digits) | Lecture attention span (10-20 Minutes)  
* Strong focus on topics valued in classroom  
* Beginning to intentionally challenge teacher authority  
* Internalizing view of skill sets  
* Comfortable planning multi-step process  
* Productive/distracting social groups  
* Beginning of puberty |  
* Activity with clear expectations.  
* Students consulted when developing activity schedule.  
* Students able to answer questions of other students.  
* Questions are open ended.  
* Opportunities for students to show aspects of project with personal value.  
* Allowing groups to decide how they will work together.  
* Introduction of techniques to follow to solve building or programming problems. |
| Grade 7th 12-13 | Reading (literary analysis)  
* Writing (“five paragraph” essays, science reports, book reports)  
* Pre-Algebra (equations with one variable) | Lecture attention span (20-25 Minutes)  
* Difficulty focusing on academic purpose  
* Teacher must earn respect  
* Focus on fairness and consistency in classroom  
* Set views of positive and negative personal abilities  
* Beginnings of abstract thought  
* Preoccupation with social status  
* Developed partner skills  
* Highly variable maturity and intelligence |  
* Students consulted when developing expectations for activities and the schedule for day.  
* Students allowed more freedom to explore the various components of the activity.  
* Work with students individually, rather than working the whole group through a problem. |
**Appealing to a Wide Range of Students**

In any classroom, you will find a wide range of skill levels, abilities and interests. It is challenging, but rewarding, to create a curriculum that peaks all of your students’ interest. Here are some strategies:

**Vary the theme of activities.** Plan your curriculum to include activities that cover a wide range of interests. Your curriculum will have an overarching theme or learning goal, and the activities you choose to accomplish these goals should vary. For example, if you are teaching an NXT unit, try not to focus all of the activities on cars because car building is likely to excite only some of your students.

**Plan extra challenges and extensions.** To keep more advanced students engaged, prepare extension activities that directly build off of the class activity. Especially early in the semester, it can be better to plan an easier, shorter challenge with many extensions than to plan one very challenging activity that no one can finish. The students will feel more accomplished and willing to take risks on the challenges.

**Make connections to the real world.** Many students express that their interest in engineering-type activities stems from the material seeming relevant to their daily life. In addition, studies have found that students (especially female students) develop a stronger connection to materials that fit into a larger context or involve helping people. So, as you prepare your activity plans for the class, strive to find a way of linking the activities to a real-world experience or problem. For example, set up an activity about water filtration by demonstrating the severity of water pollution on Earth. In another example, mentors sometimes connect the components of the NXT robot to parts of the human body.

**Understand that all students have different lived experiences.** If you suggest a connection with the real world, try to make the idea relevant and accessible to all the students in your class, regardless of cultural background, family structure or socio-economic status. Verbally explaining how a catapult works or saying “everyone knows what a catapult is, right?” is NOT as effective as showing the students a short video or a picture book. By bringing the idea into the classroom with a concrete example, everyone will have a shared experience to reference. It is impossible to have an activity centered around a cage for a bear, if none of your students have seen a bear.
CLASSROOM TIPS AND TECHNIQUES

Classroom Culture
You want your students to feel comfortable working with you, with the material, and with each other. Feeling respected and safe in the classroom, your students will be more involved in the design activities and more likely to contribute to classroom discussions. Therefore, you should strive to establish a respectful learning environment by:

- Informing the students that everyone should feel respected and comfortable during STOMP. If at any point they do not feel comfortable, let them know that they can come talk to you.

- Learn your students’ names. Bring in nametags for the first couple of classes. Knowing names makes the class run much more smoothly and it helps the students feel important to you.

- Celebrate failure! The engineering design process is not about getting the correct answer, but about the ability to understand and address problems in your projects. Students should never be penalized or made fun-of if their project fails. Make “blooper reels” if your students need help embracing failure.

- Encourage sharing of ideas. Collaboration is an important aspect of engineering. While students typically view sharing answers as “cheating” or “copying,” the idea of sharing strategies is encouraged in an engineering environment.

- Be careful of classroom competition. Friendly classroom competition can be fun and motivating for the students, but if grades or big prizes are on the line, a competition can quickly make a classroom unwelcoming. Some students may become shy if they have to compete with classmates. They may prefer a competition where they are facing a standard/goal rather than facing off with another student. This way, the success of one group doesn’t hurt the other groups.

- Speak to the students in an age-appropriate way. (Avoid sarcasm with little kids!)

- Actively listen to students. Show them that you care about their work as much as they do. Really try to hear what they are saying, not what you think they are saying.

- Express your approval for their individual work in specific ways. For example, “Great job explaining your ideas clearly to your partner,” rather than, “Good communication!” Specific praise helps your students to grow.

- Avoid general praise about students’ abilities. Try not to make global statements about a student’s capability like “You’re good at math!” Statements like these only put students in boxes and reduce their willingness to take risks.

- Create opportunities for positive dialog between students. During wrap up discussions or presentations, ask classmates to say one compliment and one idea for improvement. If you hear one student speaking negatively to another, remind him/her that engineers say helpful things to one another.
Lesson Organization
This section discusses ways to structure your class periods each week. Having a structured lesson will help your students understand and retain the lesson content. It can also help you make the most of your classroom time.

Preparation
The key to leading an organized, fluid and engaging lesson is in your preparation. Each week before your STOMP class period you should meet with your partner to make a detailed plan of your lesson. It is important to meet a few days before so that if something goes awry, you have time to remedy the situation. For example, if the equipment you wanted to use is broken, you have time to plan a new lesson and sign out the necessary equipment.

During your planning time, locate all of the materials you will need for your activity. Be sure that any CEEO or school equipment is signed out. Be sure that all equipment is functional and that you know how to use it. For example, if you are using snap circuits, be sure that you are comfortable attaching, identifying and incorporating all of the parts. Complete the challenge you are asking of the students! It can help you to predict what parts of the activity will be hardest for your students.

Lastly, decide what you are going to do for your introduction and wrap up. It is not enough to simply “lead a discussion.” Your partner and you should think about what you want the students to take away from the discussion. (See below for more specific ideas.)

Classroom Example: In one 5th grade classroom, the students’ final project was to create a toy with the NXT robotics kits. The STOMPers decided that they would start with a full-class brainstorm. They then came up with some feasible solutions to the challenge so that if the students were stuck, they would be able to give the students a starting point and inspire them to think creatively.

Introduction
Introducing the students to the daily activities should be a standardized part of your lesson plan. Even on those days where the students are continuing work on unfinished projects, a brief introduction is an effective way of setting the tone for the class.
The introduction should usually last no longer than 15 minutes and should cover the four major points described in *Table 1*.

**Table 1: An Activity Intro Structure**

<table>
<thead>
<tr>
<th>Discussion Point</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review Previous Work (1-5 minutes)</td>
<td>To help the students focus on the engineering curriculum, quickly review the work done in the last activity period, highlighting those topics relevant to the current project.</td>
</tr>
<tr>
<td>Activity Hook/Background (1-10 minutes)</td>
<td>An activity hook is an engaging method to introduce the focus points. It might be a real-world connection – for example, a demonstration or a movie. It may also be a brief lesson containing necessary background information. Keep the lesson short and exciting</td>
</tr>
<tr>
<td>Describe Challenge (1-5 minutes)</td>
<td>Briefly discuss what the engineering activity of the day. Establish activity rules and let the students general questions.</td>
</tr>
<tr>
<td>Establish Schedule (1-3 minutes)</td>
<td>Establishing a schedule for the day will assist with time management and usually makes the rest of the activity period less chaotic. You may want to write it on the side of the board for the students (and for you) to refer back to during class.</td>
</tr>
</tbody>
</table>

**Work Time**
The work time can often seem chaotic and overwhelming, depending on the different paces of the students. Here are some hints that may help keep the work time running smoothly.

- **Brainstorm as a class.** You can take a portion of the work time to consider why the design challenge has certain requirements (i.e. using only one motor or a LOOP block) and discuss how to address those requirements. Allow for ridiculous brainstorming. Let the students think freely and creatively. Remind students that there are no bad ideas during brainstorming. Even silly ideas can sometimes inspire feasible, creative solutions.

- **Have a system to choose partners.** In your first meeting with your teacher, you should discuss a system to choose partners. Note that same-sex partners tend to work better on engineering activities as they are more developmentally similar. No matter how well you choose partners, some pairings will disagree. Rely on your teacher here---he or she knows the students best.

- **Engineering Proposals.** Before beginning to work on a bigger project, you may want to ask students to complete an engineering proposal worksheet. Do not let students start a project if you know it will be
too difficult or impossible. That will only lead to disappointment. The proposals help you to assist the students and help the students to stay focused.

- **Stress that there is no one “correct” solution.** In engineering, there are always multiple solutions to each problem. Discuss how and why one solution may accomplish the goal more or less effectively than the other.

- **Schedule help.** In some cases, you may become overwhelmed with the number of students asking for your assistance and might not be able to help all the students. Because the students look highly on the engineering mentor, missing a chance to work with the volunteer can be disheartening. If you find a lot of students are asking for help, try using an ordered schedule of groups to be helped that the students can add their names to.

- **Split up the class between you and your partner.** If each of you works with the same 5 groups, the students get more helpful feedback, and you ensure no groups get overlooked.

- **Ask thought-provoking questions.** Ask a student how or why something does or does not work instead of giving them the solution. Also, allow students to test and build on their own rather than completing tasks and fixing problems for them. Answer a question with a question!

- **Make student experts.** When a student has come up with an innovative solution, make them the “expert” at that topic. Did Suzy find a good way to attach the sensor to her car? Call it the “Suzy method” and encourage other students with the same problem to ask her for advice. Make sure you clear it with Suzy though, so she doesn’t feel stressed or singled out.

- **Engineering Breakout.** When a student gains some insight that will be relevant to the rest of the class, you can stop the class for a moment and allow the student to share their discovery with the other groups. You are continuing to promote the idea that the students are learning from each other – rather than just from you. You should also recognize that everyone in the class is likely making discoveries on their own – not just the person sharing in the Engineering Breakout.

- **Reinforce the classroom ground rules for a safe space.** At the beginning of the unit, you established a set of classroom norms. If you see any students breaking the norms, gently remind them of the rules that you all agreed to. If you are consistent, the students will get better at following the norms.

- **Balance productive and deductive learning tension.** On one hand, if the mentor always provides the students with a quick solution, the students will never be challenged and will rarely feel like they accomplished anything on their own. On the other hand, letting a student pair struggle through an entire class period trying to attach a motor to the NXT brick can prevent students from reaching their full potential. Give students crucial pieces of information to empower them to move forward.

- **Schedule Clean up.** Before the work period ends, you should allocate a period of time to cleaning up the classroom. By putting the clean-up period before the daily wrap-up, the students usually complete the process faster and more efficiently in order to have time to share their projects with the rest of the class.
Wrap-Up
Unlike the consistent schedule of the introduction, the wrap-up process is fluid and dependent on the classroom progress. A few wrap-up ideas are described in Table 2.

Table 2: Possible Activity Wrap-Ups

<table>
<thead>
<tr>
<th>Discussion Point</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Updates (5-15 minutes)</td>
<td>During the Status Update, the students will either discuss their progress or show off their design solutions. When discussing student progress, you should allow students to give feedback to other groups. You should also ask students about their plans for the next activity period. If the challenge is complete, this can be time to test/demonstrate each groups solution.</td>
</tr>
<tr>
<td>Analysis of Challenges (5-10 minutes)</td>
<td>During the wrap-up period, you should help the student identify the challenges in the design process that everyone is facing. You can either model a process you use to solve design issues or encourage the students to come up with solutions together.</td>
</tr>
<tr>
<td>Review of Context (1-5 minutes)</td>
<td>After finishing with the robotic components of the lesson, you should ask probing questions to determine if the students actually understand the focus points you covered. You can also take this time to connect the activity to a larger engineering idea or process.</td>
</tr>
<tr>
<td>Question for Next Time (1-3 minutes)</td>
<td>Similar to the way you hook the students at the beginning of your Introductions, you can provide the students with questions or ideas to think about that relates to your next design challenge or to solving the current design challenge.</td>
</tr>
</tbody>
</table>
MORE RESOURCES

Tufts’ Center for Engineering Education and Outreach, located at 200 Boston Avenue, is the office out of which STOMP is based. The CEEO is on the cutting edge of the engineering education field. Through the CEEO and online, you have access to a wealth of resources to help you make the most of your time in the classroom. If you take advantage of the resources, your time as a STOMPer will be more rewarding.

Online

The STOMP website, www.stompnetwork.org, should be your first stop for any STOMP related documents or documentation. It is also home to the STOMP activity database and some pre-fabricated units. Do not be shy about using pre-made activities and units, but please remember to write comments and feedback on the activity page after doing it in your classroom. Please feel free to experiment with new activities and curricula that are not on the website. The website also has a number of important documents that you can download and print (e.g. photo release forms).

Google is another great resource! Explore teacher websites and blogs and use their activities for inspiration. Be sure that if you use an activity from another site and put it on the activity database that you cite your source! For a more detailed list of helpful websites see the STOMP website.

People

The employees and students at the CEEO can be a great resource for you during your time as a STOMP fellow. They have a wide range of experiences. Some are teachers while others are engineers. While you are around the office, feel free to introduce yourself and ask questions!

Magee Giarrosso is the Administrative Assistant of the CEEO. She will be an important person to you as a STOMP fellow. She manages the materials, the payroll and sorting hours. Lynne Ramsey aids Magee in all things CEEO, and is another great resource. Introduce yourself to Magee and Lynne at the beginning of the semester.

Elissa Milto is the Director of Outreach. She has had classroom experience and runs all our programs for kids at the CEEO. She will attend most STOMP meetings and is a good resource if you need help with curricula, classroom logistics, or problems that may arise.

Craft and Found Materials

There is a closet at the CEEO dedicated to STOMP materials. Feel free to take anything you need from the STOMP closet. When using materials, it is important to use them prudently. Wasting materials is both bad for the environment and expensive for STOMP. Take only what you need for the class and return any unused materials after your lesson. Keep the closet neat at all times.
If you use the last of something, or need something that is not in the closet, be sure to tell Magee Giarrosso at the front desk. She can order the materials for you, but you must let her know one week in advance.

You may make STOMP-related copies with the CEEO copier.

The CEEO likes to stay green, so try to manage your material use and return any materials that can be reused. Furthermore, if you want the students to brainstorm or make drawings, the CEEO prefers that you use scrap paper instead of fresh printer paper.

**Educational Technologies**

The CEEO has a lot of cool educational technology that you are encouraged to use in the classroom. Some equipment, like the NXT/EV3 kits, may be left at the school for the whole semester. Other equipment, like the laptops, goes to many classrooms and must be returned immediately after you come back. Please contact the manager at the beginning of the semester to reserve laptops or other technologies.

The CEEO is constantly experimenting with new educational technologies. You are encouraged to go to the CEEO to experiment and play with the NXTs, EV3s, snap circuits, squishy circuits, WeDos or any other equipment. The more comfortable you are with the technologies, the better you will teach them.