Best practices in Encouraging STEM Majors Among 6-12 Students

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The world is always in need of people who are interested and knowledgeable in STEM topics. Engineering Ambassadors is an initiative that involves college students who are committed to a goal of promoting STEM interest among middle and high school students. Implementing the Engineering Ambassador program in the past four years led to awareness of best practices for accomplishing this goal. To enhance the growth of those with STEM interest and knowledge, two groups of learners need consideration: Engineering Ambassadors who are the college students, and the middle and high school students served by the Ambassadors. This paper will focus on the Ambassadors and the pre-adolescent and adolescent students in Grades 6-12.

The first group is that of the college undergraduates known as the Engineering Ambassadors (EAs). At Manhattan College, the EAs are engineering or education undergraduates. During this program, 79% of Engineering Ambassadors were engineering majors who had first-hand experiences with engineering concepts. The remaining 21% were math or science education majors whose expertise included developing lesson plans and teaching to the needs of middle and high school students.

The second group comprises middle and high school students. Career choices begin forming toward the end of middle and beginning of high school. When students demonstrate an interest and talent in STEM, it is important to encourage these students in their pursuit of this interest. To measure the success of the encouragement, one must begin asking some valuable questions. Which lesson plans were most successful? Did the students seem engaged? What types of questions did the students ask the presenters? Did the students show an interest in engineering topics?

Engineering Ambassadors, along with the students, can provide insights into best practices that encourage future STEM majors.

The Engineering Ambassadors

While Engineering Ambassador programs generally define service to the college and engineering program as a primary goal, they serve an equally important but often unstated goal of developing the skills and attitudes of the Ambassadors themselves in networking with students, faculty, and other professionals. Alley, Haas, Garner, & Thole [1] describe the purpose of this networking as "… the right messenger (engineering undergraduates with advanced presentation skills) with the right message (messages about engineering) in front of middle and high school students." The framework for our Engineering Ambassador program was to establish criteria for the undergraduate to serve students in middle and high schools near Manhattan College.

The Ambassador program was uniquely designed to engage engineers in education and educators in engineering. The combination of content and methods requires the collaboration that models for students that learning is no longer competitive, but rather cooperative. A strong content

background for a teacher is a must. But, so is the need to provide pre-adolescents and adolescents with the autonomy that characterizes growth and development typical of these age groups. While there may be limitations on pre-adolescent and adolescents' abstract thinking, there is nonetheless an expanded intellectual interest. While there is increased self-involvement at this age, there is also an increased drive for independence[2].

The students served

The Engineering Ambassadors chose to work with students in Grades 6 – 12 to determine the effectiveness of the Ambassador's program. Middle grade students can still retain some of the characteristics of a scientist that they exhibited as children – natural curiosity and inquisitiveness and eagerness to discover[3]. The most recent NAEP science administered in 2015, indicated that 4th and 8th graders did better than their counterparts in 2009. However, the same was not true for the nation's 12th graders whose 2015 scores did not surpass the scores of their counterparts in 2009[4]. When the results were disaggregated by state, 2015 and 2017 math and science scores for NYS 4th graders decreased from 2009; NYS math and science scores for 8th graders seemed unchanged[5].

Given these results, there is potential for improvement. The Engineering Ambassadors worked with students in Grades 6 -12 with the hope that middle and high school students could develop a positive attitude toward math and science, anchors of the STEM program. The Ambassadors added the engineering component to math and science learning through hands-on activities and incorporated technological enhancements - for full STEM implementation.

The Ambassador program was designed around characteristics of middle schoolers salient to their learning. Middle grades are the bridge between the wants and needs of childhood and the wants and needs of high schoolers[6]. Emotionally, adolescents are self-absorbed and tend to exaggerate; they are sensitive and easily offended. Garrett-Hatfield further states that middle schoolers can be moody and feel alienated. At the same time, they are also curious about the world around them and need time to explore safely. Another salient feature of the middle school learner is their sense of wonder about the changes they see in themselves and in their peer group. They depend on important adults in their lives and good role models to emulate. One goal was to have the Ambassadors be those role models who would be emulated by the middle schoolers.

The Ambassadors provided the needed support and worked to develop relationships that made STEM activities interesting, active, engaging, and ultimately attractive enough so that middle schoolers would choose science and math in high school, and high schoolers would choose college concentrations that promote STEM. These activities were in keeping with effective middle schools promoted by the National Forum to Accelerate Middle School Reform[7]. The role of the STEM Ambassador program was to emphasize understanding important concepts and to develop necessary skills so middle and high students are challenged with engaging activities related to STEM concepts and skills.

The outreach program

The main task of the Engineering Ambassador program was the creation of effective lesson plans that would introduce engineering disciplines to middle and high school students and provide opportunities for hands-on experimental design. Rather than work with schools that already had established STEM programs, we looked at schools without STEM programs where math and science teachers were interested in using engineering principles and concepts as a practical application of their content area.

The Engineering Ambassadors collaborated in planning lessons that addressed math and science content with an engineering application. The educators focused on grade level math and science topics while the engineers considered hands-on projects that could enhance the math and science topics.

During the first two years of the program, the Engineering Ambassadors created nine multidisciplinary lesson plans.

Figure 1. Multidisciplinary Lesson Plans

Subject	Topic	Content Areas	Intended Learning	# of Presentations
Biomedical	Bone Structure & Its Relation to Electrical Systems	Biology, Mechanical & Electrical Engineering	build a leg in order to illustrate bone structure. explore the mechanical nature of the body in order to demonstrate the vastness of engineering	
Filtration & Civil Engineering	Sand Water Filter	Chemistry, Earth & Environmental Science, Environmental Engineering	apply principles of environmental engineering to water usage.	4
Fluids & Viscosity	Oobleck	Chemistry, Physics, Chemical Engineering	explain the concepts associated with viscosity and the reason for different speeds through different fluids, specifically liquids define terms associated with movement of the solids and liquids apply the concepts to “every day” liquids and solids	2
Aerospace	Egg Drop	Physics, Mathematics, Engineering Design Process	identify the basic principles of dynamics in order to construct an egg drop apparatus. discuss the experimental results of their designs in order to assess their approach.	4
Electricity	Lemon Battery Pickle Experiment	Chemistry, Physical Science, Electrical Engineering,	visualize the atomic nature of electricity. differentiate between series and parallel circuit setups.	4

Subject	Topic	Content Areas	Intended Learning	# of Presentations
		Chemical Engineering	define voltage, current, and resistance. experience the live effects of energy conversion.	
Projectile Motion & Conservation of Energy	Candy Delivery System	Physics, Mathematics, Introduction to Engineering	identify assessment and redesign as important aspects of engineering examine projectile motion investigate types of energy and how energy is transferred	
Forces & Energy	Mousetrap Car	Physics, Mathematics, Mechanical Engineering	apply Newton's Law and energy to design an effective mousetrap car demonstrate and apply design/problem-solving processes discuss and understand why certain designs are more effective than others	1
Aerodynamics	Rocket Launcher	Physics, Chemistry, Mathematics, Aerospace Engineering, Mechanical & Chemical Engineering	explore force analysis such as gravity, friction graph path of rocket launch examine the impact of lift and drag	
Civil Engineering	Spaghetti Bridge	Mathematics, Civil Engineering	explore different types of bridges experiments with effective ways of constructing bridges	

The Engineering Ambassadors were guided by engineering and education faculty in the development of the plans. Teams were established that included engineers from different disciplines and at least one educator. Engineering Ambassadors used a set lesson plan template (see Appendix A) and guidelines for creating PowerPoint Presentations that were learned in workshops attended by the EAs.

During the first two years of the program, more than 300 middle and high school students took part in the lesson plans taught by the Engineering Ambassadors. At the end of each lesson presentation, students were asked to complete a survey (see Table 1 and Appendix B) on the presentation made by the EAs. The surveys included three parts: 1) questions on the lesson plan workshop with Likert-scale responses; 2) a checklist suggesting ways to make the lesson plan workshop better; and 3) open-ended question to make additional suggestions for enhancing the lesson plan workshop.

Table 1. Student Survey with Percent Responses
(SA – Strongly Agree, A – Agree, U – Undecided, D – Disagree, SD – Strongly Disagree)

		SA	A	U	D	SD
1.	This workshop helped me understand the work of engineers.	36	49	9	5	1
2.	This workshop activities helped me think like an engineer.	35	43	15	7	0
3.	The workshops were enjoyable.	58	36	5	1	0
4.	The Engineering Ambassadors were well prepared to present this workshop.	51	40	5	4	0
5.	I learned some new engineering ideas that I did not know before.	40	41	13	5	1
6.	This workshop made me think I want to become an engineer.	24	28	31	10	7
7.	I would like the Engineering Ambassadors to come again.	55	39	4	1	1

Table 2. Checklist of Items to Improve Workshops

Items to Improve	Percent in Agreement
Have more time to work on the projects	30%
Have less time to work on the projects	1%
Have more time to listen to the engineers	19%
Have the engineers talk less	5%
Have more time for questions	8%
Have less time for questions	6%
Work in groups	29%
Work alone	3%

Figure 2. Students' Suggestions for Improving Workshops

Do you have any other ideas to make this workshop better?

- more projects/activities
- more resources/supplies
- different project
- it was cool
- come again to do more activities
- use Prezi presentation instead
- get more materials
- I think it would be more enjoyable if the engineers were able to talk more about the specifics of what they do.
- a better quantity of materials, though it is understandable that they might of not had the opportunity to get them
- make cars that work with air
- more tape and paper

- more activities/hands on
- possibly expand the material list
- more material
- give a prize to the winners and have more time
- peanut butter in a jar, more material
- if they could visit us more often or maybe at an earlier time like freshman year. It would have helped us out more
- bring food
- excellent presentation
- blow the pickle up

In addition to student surveys, the Engineering Ambassadors reflected on student learning and their own practice after each presentation. The EAs responded individually to a six-question open-ended survey (Appendix C). Responses that were general in nature are displayed in Figure 3.

Figure 3. Engineering Ambassadors' General Reflections on Lesson Presentations

Briefly describe your lesson	Which part(s) of the lesson went really well?	Which part(s) of your lesson will you do the same?	Which part(s) of your lesson will you change?	What will you do to make that change?	What knowledge and/or skill would help you in planning and presenting future lessons?
We related engineering sciences to simple experiments.	The students seemed to apply the explained aspects of the topic into the experiment.	Interacting and helping the students during the experiment.	Short and clear explanation of assigned topic.	More practice presenting the lesson before actually doing it	More ways to engage and keep the students interested in the presentation.
Each project incorporated Engineering Design Principles and background information on who engineers are and what they do			PPT need more explanation and fewer words	Change presentation slides – too much text	
Answered questions on theories and gave advice for the students design ideas.			Give students more time to engage and explain	Allow for more time before/after presentation to talk about what happened and why	Balance of fun and education. Should be fun while learning; they would retain more information if the activity was fun
				Talk with students while they are designing the project	Knowing what engages students most; knowing a bit of background

Briefly describe your lesson	Which part(s) of the lesson went really well?	Which part(s) of your lesson will you do the same?	Which part(s) of your lesson will you change?	What will you do to make that change?	What knowledge and/or skill would help you in planning and presenting future lessons?
					about the school would help

Lessons delivered most often (Egg Drop, Lemon Battery Pickle, Filtration) had specific suggestions and modifications for improving the learning for students and presentation for EAs.

Figure 4. EAs Reflections on Egg Drop, Lemon Battery Pickle, Filtration

Lesson Topic	Briefly describe your lesson	Which part(s) of the lesson went really well?	Which part(s) of your lesson will you do the same?	Which part(s) of your lesson will you change?	What will you do to make that change?	What knowledge and/or skill would help you in planning and presenting future lessons?
Egg Drop	Aerodynamic concepts like drag force and spring force. The students took those ideas and applied them to the design process of building a parachute for the egg to land safely. They used paper, popsicle sticks, and tape to cushion an egg drop	The hands-on section The presentations	Hands-on section Time management	Students didn't have enough time to develop their ideas fully. Students didn't fully discuss after the lesson to further develop their under-standing PPT explanation More emphasis on area of parachute and	More time at the end to discuss what we observed and what methods were more successful and why. Talk a little bit slower. Give more background on the concepts Talk about concept more in the presentation	Knowledge for communi-cating and discussing with a group of students would be helpful. For example, discussing more about the topic to make sure the students fully understand what happened. Speaking a little bit slower. Explain more about the concept -

Lesson Topic	Briefly describe your lesson	Which part(s) of the lesson went really well?	Which part(s) of your lesson will you do the same?	Which part(s) of your lesson will you change?	What will you do to make that change?	What knowledge and/or skill would help you in planning and presenting future lessons?
				spring of padding	and while they are designing	how and why it works.
Lemon Battery	Students used a lemon battery to power an LED light; explored series/parallel circuits, Lemon Battery was a mix of chemical and electrical engineering - wiring copper and zinc materials to the lemon and to each other to power LED	The lemon battery wiring The presentation The hands-on part of the lesson	The hands-on part of the lesson Interacting with the students during the hands-on part	The PPT explanation	Talk a little bit slower. Give a little bit more background on the concepts. Offer more help	Effectively communicate a topic using a small amount of text on a slide. Use pictures to show a concept. Speaking a little bit slower. Explain more about the concept How and why it works.
Filtration	Helped students design and build a water filtration system	The hands-on activity The PPT presentation	The hands-on activity The PPT presentation	Maybe wash/the filter first to get it wet before actual filtration Rinse GAC and maybe have different groups make different filters	Wash GAC and other and other materials before using it in the presentation The lesson is great as it is	Know the science or logic behind filter knowing more about civil and enviromental/ geotechnical topics to explain why and how sand and GAC filter better performing the hands-on ourselves

Lesson Topic	Briefly describe your lesson	Which part(s) of the lesson went really well?	Which part(s) of your lesson will you do the same?	Which part(s) of your lesson will you change?	What will you do to make that change?	What knowledge and/or skill would help you in planning and presenting future lessons?
						before the visits

Findings for promoting best practices for Grade 6-12 students

This paper considered two groups who contribute to promoting best practices for encouraging STEM majors: Engineering Ambassadors and the students they served in Grades 6-12. While the focus of this paper is on best practices for the latter group, these students would not have had these STEM opportunities if the Engineering Ambassadors had not created engineering related projects and engaged the students in the projects. The first set of findings will focus on best practices learned for encouraging STEM majors among 6th -12th grade students.

Practices for encouraging Grade 6-12 students

Despite definitive research focused on effective practices to encourage students to consider STEM careers, research suggests five practices that address these needs: (1) solid preparation in math and science programs from an early age; (2) student experience with hands-on content in math and science; (3) connections of learning to the workplace; (4) exposure to role models and mentors; and (5) access to peers who share interests in these same fields[8]. Four of these practices were used to encourage these students.

Each engineering related project included a hands-on task that was problem-based and related to math or science. Based on the students' survey responses, 94% strongly agreed or agreed that the activities presented by the EAs were enjoyable. Studies [9, 10, 11, 12] have shown that STEM learning that is hands-on and problem based positively influences students' academic and non-academic performances.

Research[13] indicates that students who engage in these types of learning experiences show positive attitudes toward learning itself, collaborative behavior, and team communication. Students' interests, self-confidence, and self-efficacy developed especially when the tasks related to real-world experiences. Eighty-five percent of the students strongly agreed or agreed that the workshops helped them understand the work of engineers, and 78% reported the workshop helped them think like engineers. More than half the students reported that the workshop made

them think that they may want to become engineers. Additionally, 81% reported they learned some new engineering ideas they did not know before the workshop.

Another best practice that encouraged the students to consider STEM areas of interest was the exposure these students experienced in working with the Engineering Ambassadors as mentors and models. Research[14] has shown that students benefit from positive role models in STEM careers who are close to them in age. The EAs are close to the ages of these students, acted as engineering role models, delivered engaging and inter-active presentations, and challenged and questioned these students during the presentations. The survey reported that 94% of the students wanted the engineers to come again. When students made suggestions for improving the experience, 19% wanted more time to listen to the engineers. Students' suggestions stated: "Come again and do more activities", "I think it would be more enjoyable if the engineers were able to talk more about the specifics of what they do.", and "If they could visit us more often or maybe at an earlier time like freshman year. It would have helped us out more."

One other best practice that came from this experience was the use of surveys to capture students' responses to the STEM related projects. The student survey allowed the participants to reflect on the learning experience and to consider their own thinking as it related to considering STEM related activities and their future careers. The surveys were invaluable to the Engineering Ambassadors who made the presentations as well as the engineering and education faculty and other EAs who were not able to attend the presentation.

In summary, three best practices relating to encouraging Grade 6-12 students in considering STEM majors surfaced. These practices include:

- Designing STEM related projects that engage learners, foster collaboration, and relate to real-life experiences
- Exposing Grade 6-12 students to STEM mentors and models
- Using surveys to capture learning and reactions to STEM.

One other conclusion drawn from the experience was the need for more frequent visits to the students to help them see the practical application of their math and science learning in an engineering related project.

Practices for Engineering Ambassadors in working with students

The second group critical to encouraging STEM majors were the Engineering Ambassadors. EAs planned STEM related projects to bring to Grade 6-12 students. At Manhattan College, a best practice that arose was the collaboration of two schools: School of Engineering and School of Education.

The Engineering Ambassador program had been in existence at Manhattan College for two years. Upon being awarded a collaborative NSF grant between the two Schools, education undergraduates were invited to join the engineers in this club. The main purpose of the club was for Engineering Ambassadors to create engineering related projects that they would present at middle and high schools in the geographic area in proximity to the College.

The collaboration between undergraduate engineers and educators is one of the best practices that came from the experience. Engineer EAs had background in engineering principles and projects while education EAs had experience with creating developmentally appropriate lesson plans to meet State requirements in learning math, science, and technology. The EAs worked in inter-disciplinary teams that included mechanical, electrical, civil, and/or environmental engineers and at least one educator. Each team decided on a topic in math or science and determined an engineering project.

This collaboration could lead to another initiative for future STEM teachers. A program at the University of Colorado Boulder is assisting engineering majors in acquiring teaching certification in addition to their engineering degree[15]. The pathway to teaching allows engineering students to share their passion for engineering in an alternate career. Early findings from the program reveal the following:

> We found the future career plans of these students enlightening. The program designers originally anticipated that the teaching pathway would mostly feed directly to secondary math and science classrooms, so it is wonderful to see that the students have myriad different plans. While some want to make a traditional move from a teacher licensure program to teaching in K-12 settings, others envision pathways such as practicing engineering first and then teaching later, and alternative industry roles that capitalize on teaching skills. The combined passion for engineering and teaching has the potential to manifest in a great diversity of future endeavors (p. 44).

While the findings in this experience do not relate directly to the Colorado program, the collaboration of the two schools may pave the way for this new initiative in attracting future engineers and educators.

The projects were another best practice in this experience. The engineering related project made explicit the practical application of the math/science content. Each project was problem based and required students to use the engineering design principles in developing the project. Several iterations of the lesson plans helped the EAs identify appropriate content, revisit developmentally appropriate strategies for presenting the content, and continued consideration for meeting the needs of pre-adolescents' and adolescents' sense of autonomy, abstract thinking, and intellectual interest[16]. As noted previously, 94% of students who participated in the projects strongly agreed or agreed that the workshops were enjoyable.

School visits required a careful consideration of which plans to present to the students. Of the nine developed plans, only 5 were brought to the actual classrooms. All plans had been approved by College faculty for teaching, but not all plans could be effectively presented. Some of the plans (Bone Structure, Mouse Trap, and Spaghetti Bridge) required more time for the hands-on project than was allocated to the Ambassadors during the visit. Two plans (Candy Delivery System and Rocket Launcher) required extensive space that was not readily available in the school or not possible outside the school because of weather. Egg Drop was only possible in settings that had a launch space. Mousetrap Car, while highly interactive and competitive,

required materials that were cost prohibitive. Engineering Ambassadors continue to consider other options for using these plans or redesigning them to meet needed specifications.

Engineering Ambassadors reflected on what they observed and learned in the presentation of the projects to the middle and high school students. After each teaching episode, the EAs individually reflected on the experience and responded in writing to the questions (Appendix C). Figures 3 and 4 summarize the reflections of the EAs.

Generally, the EAs were satisfied with the presentations. The parts of the lesson they identified as worth repeating were the hands-on projects. Frequent mention was made of the effectiveness of the PowerPoint presentations that were a part of each lesson. The EAs identified areas in need of improvement including PowerPoints with fewer words and more graphics, speaking slower and providing more background information on the concept, giving students more time for engaging and explaining the project, communicating more effectively with the students during the hands-on part of the lesson, providing and maintaining a balance between learning the concept and having fun with the concept, and practicing the lessons before the visits to the schools.

This reflective piece became another best practice in this experience. Reflection plays a major role in developing careful consideration of multiple aspects of the lesson and the experience. In addition, reflection promotes a habit of continuous learning from their experiences by examining problems encountered, devising a plan to address these problems, and taking action to make change happen[17].

In conclusion, three best practices for Engineering Ambassadors for encouraging STEM majors among students in Grades 6-12 are:

- Design engineering related projects that are practical application of math and science learning and balance conceptual development and enjoyment
- Collaborative teaming between engineers and educators in developing the lesson plans
- Reflective practice as a part of planning, teaching, and communicating with students.

Conclusions and recommendations

From this experience, best practices in encouraging STEM majors among Grades 6-12 students can be used in other settings. The three best practices specifically noted for encouraging middle and high school students and the three best practices for the EAs in working with these students contribute to the promotion of engineering education. While all six practices are strongly encouraged, engineers and educators can select the practices that best meet the needs of students in middle and high school settings. These practices can also be adapted in working with elementary students.

Continued studies should be made on relating the practical application of math and science lessons through engineering projects. As science educators are now required to teach engineering concepts and principles as described in the Next Generation Science Standards, and few current science teachers have engineering backgrounds, these types of lesson plans can be a starting point for infusing engineering in science programs.

Studies are emerging on college students as mentors and models of STEM. Because of the close proximity in age between Grades 6-12 students and undergraduates, the passion for learning and communicating STEM subjects by Engineering Ambassadors can clearly place the right messenger (EAs) with the right message about STEM for middle and high school students who are still deciding on future careers[18].

Finally, a collaboration between engineers and educators has great potential for encouraging STEM majors in middle and high school. The innovative program at University of Colorado Boulder results in graduates attaining two degrees concurrently – engineering and teaching. They are preparing a workforce of middle and high school educators capable of teaching in multiple STEM subjects and motivated to pursue two careers because they find value in both[19].

The initiative at Manhattan College is creating a new collaboration among engineers and educators who formerly never met. Engineers are considering education and educators are considering engineering. This is in early stages on our campus. When engineers and educators work together in planning lessons for middle and high school students, they learn more about each other's profession. A mutual respect and admiration for both careers emerge.

Each of these conclusions and recommendations can lead to greater encouragement of STEM majors among our middle and high school students.

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APPENDIX A - Lesson Plan Format

Objective: Students will...

Overview: Give a brief description of the lesson.

Background: What do students need to know to complete and understand this lesson. How will you activate their prior knowledge? (PowerPoint Presentation?)

Materials:

Preparation:

Procedure: Step by step instructions for conducting the lesson.

1.Sponge Activity (activity that will be done as students enter the room to get them into the mindset of the concept to be learned)

2. Direct students' attention to the objective. Students will…Provide focus questions.

3. Activate students' prior knowledge … What information will be shared with/among students to connect to prior knowledge/experiences?

4. Guide students through lesson/activity

Final Activity: Today we …

This section should include how to conclude the lesson. Action/Statement by teacher designed to bring lesson presentation to an appropriate close.

Assessment:

Appendix B – Student Survey

Student Survey

Thank you for participating in our Engineering Education Workshop. Please take a few minutes to complete this survey on your experience.

Directions: Please choose one response for each statement.

		SA	A	U	D	SD
1.	This workshop helped me understand the work of engineers.	○	○	○	○	○
2.	This workshop activities helped me think like an engineer.	○	○	○	○	○
3.	The workshops were enjoyable.	○	○	○	○	○
4.	The Engineering Ambassadors were well prepared to present this workshop.	○	○	○	○	○
5.	I learned some new engineering ideas that I did not know before.	○	○	○	○	○
6.	This workshop made me think I want to become an engineer.	○	○	○	○	○
7.	I would like the Engineering Ambassadors to come again.	○	○	○	○	○

8. Check all things you think would make this workshop better

Have more time to work on the projects	
Have less time to work on the projects	
Have more time to listen to the engineers	
Have the engineers talk less	
Have more time for questions	
Have less time for questions	
Work in groups	
Work alone	

9. Do you have any other ideas to make this workshop better?

Engineering Ambassador Survey

Thank you for participating in our Engineering Education Workshop. Please take a few minutes to complete this survey on your experience.

Lesson Topic: School:

1. Briefly describe your lesson.

2. Which part of the lesson went really well?

3. Which part(s) of your lesson will you do the same?

4. Which part(s) of your lesson will you change?

5. What will you do to make that change?

6. What knowledge and/or skill would help you in planning and presenting future lessons?