

Concord Evaluation Group

# Invent It. Build It. 2014: Evaluation Report

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# Table of Contents

Summary .....	1
Background .....	5
Study Design .....	7
Findings .....	8
Girls .....	8
Characteristics .....	8
Results .....	9
Suggestions for Improvement .....	15
Parents and educators .....	21
Characteristics .....	21
Results .....	22
Suggestions for Improvement .....	28
EXPO participants .....	31
Characteristics .....	31
Results .....	32
Suggestions for Improvement .....	32
Appendix A: Schedule of Events and Activities .....	A-1
Appendix B: Activity Sheets .....	B-1
Appendix C: Survey Instruments .....	C-1

# Summary

The fifth annual *Invent It. Build It.* event, sponsored by the Society of Women Engineers (SWE), Girl Scouts of the USA, WGBH's Design Squad Global, the ExxonMobil Foundation, and Techbridge was held at the SWE annual conference in Los Angeles, CA. Participants included a record-breaking 619 middle school girls, plus 300 of their parents/guardians and middle school educators.

More than 200 SWE members volunteered at the event to facilitate the activities, act as role models, and work closely with the middle school girls throughout the day. Thirty-two exhibitors provided information about camps, competitions and resources as part of the *Invent It. Build It.* EXPO.

Concord Evaluation Group was hired to conduct an independent evaluation of the event. This report summarizes the evaluation findings.

The evaluation provided strong evidence that SWE was able to achieve its goals for *Invent It Build It.* The event...

- Changed girls' attitudes about engineering careers by exposing them to different ways of thinking about engineering.
- Engaged girls in two different hands-on engineering activities to build their self-confidence and critical thinking skills as they relate to engineering.
- Enabled girls, parents, and educators to meet and network with engineering role models, especially females ones.
- Helped girls draw connections between their career passions and engineering by sharing personal stories and celebrating the accomplishments of women engineers.
- Developed girls' understanding of what engineers do by interacting with the SWE volunteers.
- Enabled girls to identify what the next steps of becoming an engineer are by interacting with the SWE volunteers.

*"I felt like a mini engineer."*

-Middle school girl

After the event, girls were significantly more likely to report that they were interested in becoming an engineer than before (33% were reported they were interested before and 51% reported that they were interested after) and many girls (62%) saw a connection between their interests/passions and engineering. This is likely due, in part, to the fact that girls' understanding of the field greatly

increased (from 64% to 91% of girls understanding engineering) after the event. By the end of the event, girls realized that engineering was creative, hands-on, encompassed diverse fields, had a societal impact, was innovative and fun.

The event also helped girls to build their confidence and self-efficacy with respect to engineering and design process skills. Nearly two-thirds of girls reported increases in their confidence in building and designing and their ability to use the design process. More than half of girls reported an increase in their ability to think of many different possible ways to solve a problem and their confidence in problem-solving.

*"I enjoyed the whole thing, especially listening to the different inspiring women speak."*

*-Middle school girl*

What girls told us they liked most about the event was that they were able to spend the day doing challenging, hands-on, creative activities. Girls also reported that their favorite part of the event was working with engineers, learning about them and what they do. Many of the girls (89%) reported that they worked with an engineer mentor at the event who was helpful and easy to talk to. Girls also reported that they had fun and that they met new friends and enjoyed the teamwork aspect of the event.

*"Being a part of this event made me realize that science is way more fun than I thought."*

*-Middle school girl*

The Touchdown hands-on activity was rated highly overall while Dance Pad Mania was rated moderately. Girls rated Touchdown higher with respect to the extent to which the activity demonstrated the connection to engineering, was fun, and encouraged creativity.

Many of the girls reported that they would recommend that other kids participate in events like this (83%). Most girls reported that they enjoyed the fact that the event was just for girls (83%).

About two-fifths of the sample of girls reported that they were Girl Scouts (41%). Of the remaining girls, the majority (71%) reported that they were possibly or definitely more interested in being involved with the Girl Scouts after attending the *Invent It. Build It.* event.

The feedback from adults who attended the event was very positive. All but two adults reported that they would recommend the *Invent It. Build It.* event to others (99%). Nearly all the participants agreed or strongly agreed with the following statements:

- This event helped me learn where to find resources for girls/my daughter (94% of all adults and 92% of non-engineers).
- I feel empowered to help more girls/my daughter become an engineer someday if they want to (93% of all adults and 90% of non-engineers).
- I had fun today (93% of all adults and 92% of non-engineers).
- This event helped me feel well-equipped to talk with girls/my daughter about a career in engineering (92% of all adults and 91% of non-engineers).
- This event taught me some activities I can do with girls/my daughter (92% of all adults and 91% of non-engineers).
- My goals were met today (92% of all adults and 90% of non-engineers).
- This event helped me understand why engineering is a good career choice (90% of all adults, including non-engineers).
- This event helped me understand what engineers do (90% of all adults and 91% of non-engineers).
- I had a chance to meet professional engineers today (88% of all adults and 86% of non-engineers).
- This event helped me understand why there are so few women in engineering (79% of all adults and 80% of non-engineers).
- This event helped me to understand what it takes to become an engineer (79% of all adults and 80% of non-engineers).
- All my questions were answered today (74% of all adults and 75% of non-engineers).

*"I never thought to think of engineering as a helping profession."*

-Parent

We asked adults to report what they learned at the event that they didn't know beforehand. The most popular response was that they learned new information about the field of engineering. Next, adults reported that they were able to learn about resources that they previously did not know about.

Others learned that an individual does not need to be a perfect student in order to succeed in engineering. Others reported that the event helped them learn more about the perspective of female engineers. Finally,

two adults reported learning new information about their daughters and engineering.

We also asked EXPO participants what they liked most about the EXPO. More than half (62%) mentioned the hands-on activities. More than a quarter (28%) mentioned the information and outreach offered to participants. Participants reported that they also appreciated the opportunity to be exposed to other organizations and programs as well as the excitement of the participants (23%).

Finally, the girls and adults offered excellent suggestions for improving the *Invent It. Build It.* event. Detailed suggestions for improving the event are included in the Findings section.

# Background

On October 25, 2014 the Society of Women Engineers (SWE), Girl Scouts of the USA, WGBH's Design Squad Global, the ExxonMobil Foundation, and Techbridge held the fifth annual day-long collaborative event *Invent It. Build It.* for middle school girls at the SWE annual conference in Los Angeles, CA. SWE invited middle school girls, their parents/guardians, and middle school educators (both formal and informal educators) to participate.

A record-breaking 619 middle school girls attended the event, along with over 300 parents and/or educators. Deysi Melgar, a cast member from Season 2 of WGBH's *Design Squad*, served as the special host of the event. In addition, more than 200 SWE members volunteered at the event to facilitate the activities, act as role models, and work closely with the middle school girls throughout the day, including acting as "Roving Engineers" during check-in. Thirty-two exhibitors provided information about camps, competitions and resources as part of the *Invent It. Build It. EXPO*. The schedule of events and activities for the girls as well as their parents and educators are included in Appendix A.

The purpose of the event was to:

- Change girls' attitudes about engineering careers by exposing them to different ways of thinking about engineering.
- Engage girls in 2 different hands-on engineering activities to build their self-confidence and critical thinking skills as they relate to engineering.
- Enable girls, parents and educators to meet and network with engineering role models.
- Help girls draw connections between their career passions and engineering by sharing personal stories and celebrating the accomplishments of women engineers.
- Develop girls' understanding of what engineers do by interacting with the SWE volunteers.
- Enable girls to identify what the next steps of becoming an engineer are by interacting with the SWE volunteers and local STEM organizations at the EXPO.

The kids spent the majority of their day engaging in two different hands-on engineering activities with engineer mentors. These activities included:

- **Touchdown** – Kids were asked to design and build a shock-absorbing system that will protect two "astronauts" when they land.
- **Dance Pad Mania** – Kids were asked to build a dance pad that lets them use their feet to flash a light.



The kids' detailed activity sheets are included in Appendix B.

Parents and educators were invited to spend the day engaged in a separate set of activities—networking with engineers and each other, participating in a panel discussion with SWE members and outreach experts.

# Study Design

Concord Evaluation Group (CEG) conducted an evaluation study to learn about the event's impact on girls as well as to discover ways to enhance *Invent It. Build It.* events for future implementation. CEG developed three surveys and a comment card to collect feedback on the event from its participants. These data collection instruments are included in Appendix C.

One survey was administered to girls at the end of the day. The second survey was administered to parents/educators at the end of the day. The third survey was administered to exhibitors at the end of the EXPO. During the event, we also asked girls to complete a comment card after they completed both of the hands-on engineering activities and the EXPO (Figure 1).

<b>Activity allowed me to be creative.</b> <i>disagree</i>   1   2   3   4   5   <i>agree</i> <i>neutral</i>	<b>Overall this activity was...</b> <i>poor</i>   1   2   3   4   5   <i>excellent</i> <i>good</i>	<b>I see the connection between this activity and what engineers do.</b> <i>disagree</i>   1   2   3   4   5   <i>agree</i> <i>neutral</i>	
	<u><b>Expo</b></u>		
	<b>This activity was fun.</b> <i>disagree</i>   1   2   3   4   5   <i>agree</i> <i>neutral</i>		

Figure 1. Comment card.

# Findings

## Girls

### Characteristics

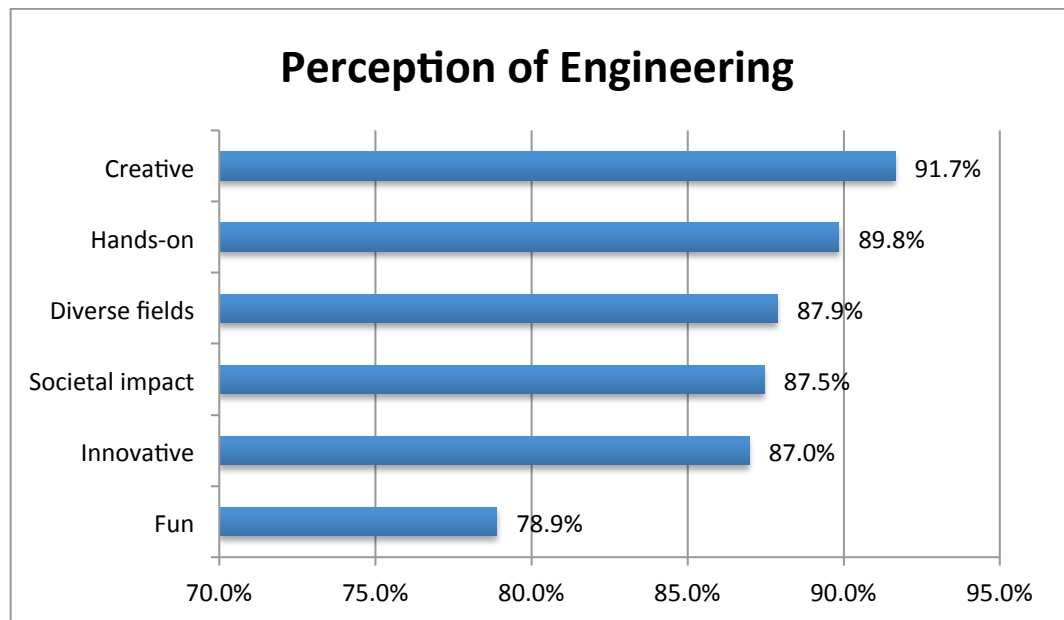
As in previous years, the girls who attended the event were from diverse backgrounds. More than half the girls identified themselves as Hispanic, Latina, or Spanish (53%), 35% were white, 19% were Black or African-American and 18% were Asian American. The remaining 9% were Native Hawaiian or Native American. Compared to last year, proportionally more girls identified themselves as Hispanic, Latina, or Spanish and proportionally fewer girls identified themselves as Black or African-American (11% and 52% last year, respectively). The girls ranged in age from 8 to 18 years of age, and the average age of the girls was 11.79 years old (with a standard deviation of 1.03 years).

**Table 1:**  
**Girls' Background Characteristics**

	<b>Number and Percent</b>
<b>Race/ethnicity (N = 444)</b>	
Hispanic, Latina, or Spanish	233 (52.5%)
White or European American	157 (35.4%)
Black or African-American	82 (18.5%)
Asian American	78 (17.6%)
Native American or Alaskan Native	23 (5.2%)
Native Hawaiian or Pacific Islander	15 (3.4%)
<b>Age (N = 490)</b>	
Eight	1 (0.2%)
Nine	1 (0.2%)
Ten	29 (5.9%)
Eleven	185 (37.8%)
Twelve	150 (30.6%)
Thirteen	108 (22.0%)
Fourteen	13 (2.7%)
Fifteen	2 (0.4%)
Eighteen	1 (0.2%)

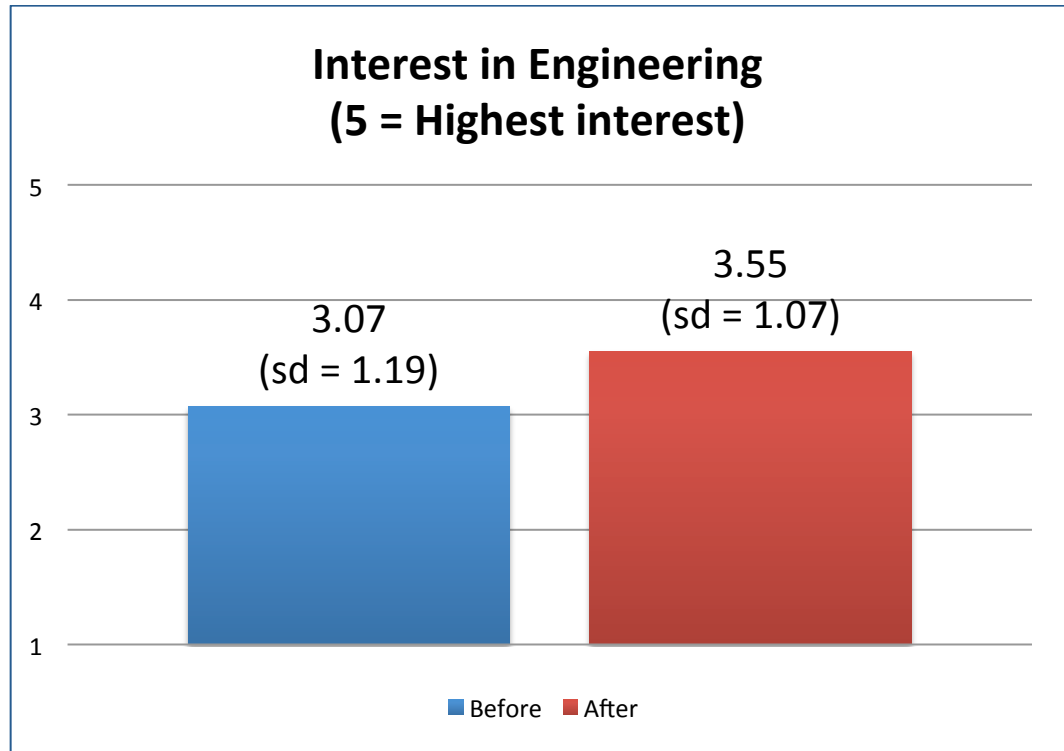
## Results

Since one objective for the event was to encourage girls to think about engineering as a future career choice, we asked girls to indicate the extent to which they believed that engineering embodied desirable characteristics of a future job. Most girls perceived that engineering was creative (92%) and hands-on (90%). Most girls also agreed that engineering could be used in many different careers (88%), allowed one to help one's community (88%), and was innovative (87%). Finally, most girls agreed that engineering was fun to do (79%) (Figure 2). Girls' perception of engineering was similar to last year's girls' perception of engineering.



**Figure 2. Perceptions of engineering.**

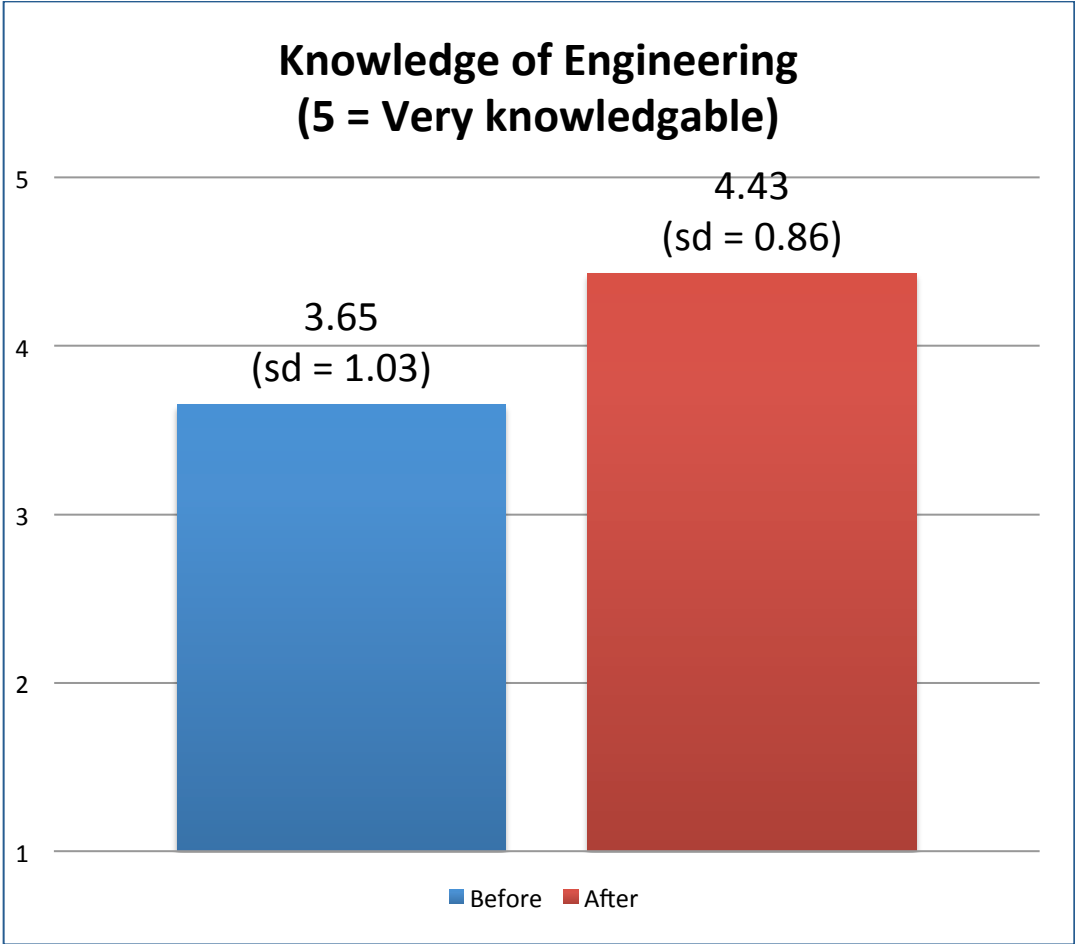
We asked girls to report how their attitudes and interest in engineering changed, if at all, as a result of participating in the *Invent It. Build It.* event. Thirty-three percent of girls told us they were interested in becoming an engineer before the event, and this increased to 51% after the event (Figure 3). In fact, similar to last year, the difference between girls' reported interest in engineering before and after the event was statistically significant and large (see effect size below). Further, 62% of girls saw a connection between their interests/passions and engineering.



Note: Paired t-test (df = 515) = 7.4995,  $p < 0.0001$ , Cohen's d effect size = 0.42.

Figure 3. Average level of self-reported interest in becoming an engineer before and after *Invent It. Build It.*

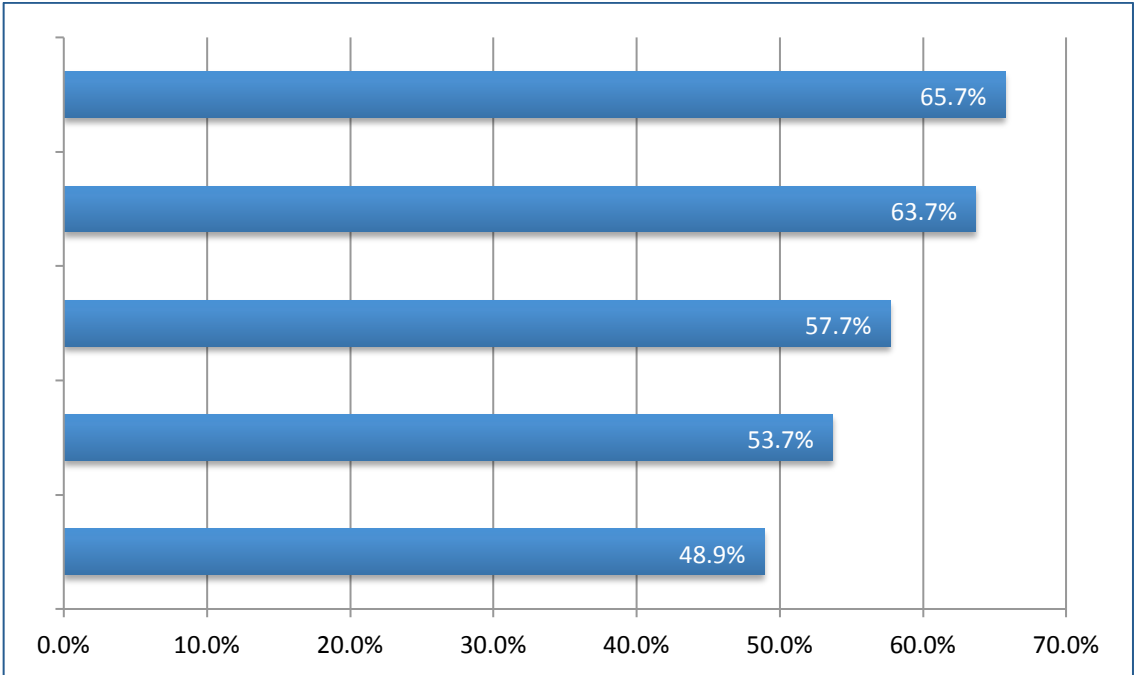
We asked girls if they knew what an engineer did before and after the event. Sixty-four percent of girls reported that they knew what an engineer did before the event. This number increased to 91% after the event. Again, similar to last year, the difference between girls' reported engineering knowledge before and after the event was statistically significant and large (see effect size below).



Note: Paired t-test (df = 521) = 13.4607,  $p < 0.001$ , Cohen's d effect size = 0.822.

Figure 4. Average level of self-reported knowledge about engineering before and after *Invent It. Build It.*

Another one of the event goals was to increase girls' confidence in engineering-related skills. We found that most girls reported improvements in: their confidence in building and designing (66%), their ability to use the design process (64%), their ability to think of many different possible ways to solve a problem (58%), their confidence in problem-solving (54%), and their ability to brainstorm solutions (49%). The proportions of girls who reported improvements in their ability to think of many different possible ways to solve a problem and their ability to brainstorm solutions was slightly, but not significantly, lower this year as compared to last year (64% and 60% last year, respectively). Since the program approach did not change, this is likely due to differences in the population being assessed (last year's event was held in a different city, Baltimore, MD).



**Figure 5. Proportion of girls' who reported improvements in engineering-related confidence and abilities after participating in the *Invent It. Build It.* event.**

Nearly all girls rated the event highly, grading it 'A' (62%) or 'B' (33%). We asked girls what they liked most about the event. Of the 523 girls who responded to this question, most simply listed the activities that they enjoyed doing – 28% reported that Dance Pad Mania was the thing they liked most about the event, while 18% reported that Touchdown was their favorite part of the event and 15% particularly enjoyed the EXPO. Seven percent appreciated the food.

Many girls reported that they enjoyed the fact that they were able to spend the day doing challenging, hands-on, creative activities:

- *It was a craft that you had to think and use your imagination.*
- *I liked the hands-on learning.*
- *I enjoyed building new things.*
- *I liked the way we can actually build something and make our own things that we want.*
- *We used our ideas and got to build it ourselves.*
- *When we tried to make things we didn't know what to do.*
- *I liked how I was creative in building. I also liked how these things were hard.*
- *Learning techniques and designs. Also, I liked building and testing.*
- *I like inventing new things because I got to show my creativity and it was very fun to do.*
- *We had the chance to be creative and use our brains a little more.*
- *The most I liked about the event was where we got to make things and use our imagination.*
- *I loved how I got to use my creativity.*
- *The building part. I love to build things.*
- *Hands-on experiments were so much fun!*
- *The challenges we faced during the activities.*
- *Being creative and making things.*
- *What I like most about today was that we got to do different activities and create like an engineer.*
- *We got to create mini projects. I felt like a mini engineer.*
- *I liked that I got to invent and be creative.*
- *Being able to be creative like an engineer for one day.*
- *I liked having to think hard and solve problems.*

Others reported that their favorite part of the event was working with engineers, learning about them and what they do:

- *I like the fact that the engineers taught us how to make everything.*
- *I liked that we got to actually make different things and listen to professionals talk about their experience.*
- *I enjoyed the whole thing, especially listening to the different inspiring women speak.*
- *My favorite part was listening to different engineers telling us about their jobs.*
- *I liked having a chance to make things and ask engineers questions.*
- *It gave me more knowledge on what I want to do in life.*
- *How many variations of engineering there was and how well it was represented.*
- *I liked getting to learn about what engineers do.*



- *Learning how the fun activities we did today were a part of an engineer's job.*
- *I liked the explaining of how Deysi became an engineer. It helped me understand more about an engineer's purpose.*

Some girls reported that they had fun and that they met new friends:

- *Being a part of this event made me realize that science is way more fun than I thought and all the activities were awesome.*
- *Doing projects with my friends and new people. I liked meeting new people today, too.*
- *I liked being creative and learning new things with new people.*
- *I had fun!*
- *The fun activities and talking with my friends.*
- *Working with other people who I have never met.*
- *Working with new friends.*

Others reported that they enjoyed the teamwork aspect of the event:

- *I liked working with my partner on the astronaut project.*
- *I liked working together in the first project to achieve team goal.*
- *How we all work together to find out it works.*
- *That we were working together.*

We asked the girls to comment on both activities, Dance Pad Mania and Touchdown, immediately after they completed them. For each activity, we asked the girls to rate the extent to which they thought the activity was poor to excellent, the extent to which they saw a connection between this activity and what engineers do, whether the activity was fun, and whether the activity allowed them to be creative.

The highest rated activity overall was Touchdown (91% rated it as good or excellent), followed by Dance Pad Mania (69%). There was a statistically significant difference between the activities in terms of the overall ratings – Touchdown was rated higher than Dance Pad Mania ( $t_{(df=1013)} = 9.2758$ ,  $p < 0.0001$ ). Further, Dance Pad Mania was rated higher last year (83%).

Regarding relevance to engineering, most girls reported that Touchdown and Dance Pad Mania were both successful at demonstrating the connection to engineering (92% and 83%, respectively). Girls rated Touchdown as significantly more successful than Dance Pad Mania ( $t_{(df=1003)} = 3.5599$ ,  $p < 0.001$ ). Additionally, Dance Pad Mania was rated as much more relevant to engineering last year (91%).

We asked girls to tell us whether they felt the activities were fun. Many (90%) girls reported that Touchdown was fun. Statistically significantly fewer (72%) girls reported that they the Dance Pad Mania activity was fun ( $t_{(df=1016)} = 8.7214$ ,  $p < 0.0001$ ).

Finally, we asked girls to rate the extent to which each activity enabled them to be creative. Touchdown was the significantly higher-rated activity (94% agreed or strongly agreed that it enabled them to be creative), while 71% agreed that Dance Pad Mania enabled them to be creative ( $t_{(df=1004)} = 11.8657$ ,  $p < 0.0001$ ). Also, Dance Pad Mania was rated as allowing more creativity last year (90%).

We also asked girls to rate the EXPO using the same criteria. Most (89%) girls rated the EXPO highly overall, saw the connection between the EXPO and what engineers do (87%), felt the EXPO allowed them to be creative (86%), and found the EXPO to be fun (91%).

Most of the girls (76%) know how to find out more about engineering if they want to and many girls (64%) know their friends would support their interest in engineering. Most girls reported that they would recommend that other kids participate in events like this (83%); only 8 reported that they would not. This rating is down from 99% last year. Most girls reported that they enjoyed the fact that the event was just for girls (83%), up from 77% last year. Most of the girls (89%) reported that they worked with an engineer mentor at the event who was helpful and easy to talk to, down slightly from last year (94%). Again, since the program approach did not change significantly, these differences may simply be due to naturally occurring differences in the populations being assessed from year to year.

About two-fifths of the sample of girls reported that they were Girl Scouts (41%). Of the remaining girls, many (71%) reported that they definitely or might be more interested in being involved with the Girl Scouts after attending the *Invent It. Build It.* event.

### Suggestions for Improvement

We asked girls to tell us what they would change about the event, if they could. Nearly one-fifth of the girls (19%) reported that they wouldn't change anything about the event. This proportion is down from 40% last year. For example, some girls reported:

- *I would not change anything. I believe it is amazing just the way it is.*
- *I won't change anything because everything is great.*
- *I wouldn't change a thing about this event - it was perfect.*
- *I would not change anything because everything I learned was fun.*

- *If I was in charge I wouldn't change anything. I love this event!*
- *I wouldn't change this event. It was perfect the way it is.*
- *The event was nice and I would not change anything.*
- *I wouldn't. It's perfect the way it is.*
- *I wouldn't! I loved it!*
- *I really like the way it is so I'm pretty sure I wouldn't change anything.*
- *I wouldn't change anything because everything seems perfect the way it already is.*
- *I wouldn't change it because it was so much fun today!*
- *If I was in charge of this event I don't think I would change anything because it was fun and informative.*
- *I don't think I would change this event because to me it came out smooth and fun.*

The most common suggestion was to add more activities or more time for activities or the EXPO. Some girls reported:

- *I would possibly give a little more time in some activities. Though overall everything was excellent.*
- *If I was in charge I would add more time for more events.*
- *I would give more time to work on the projects.*
- *I would change it by adding more activities*
- *This event was already fun but I would have had more projects and more time.*
- *I would do more hands-on activities.*
- *I would make more games to do and have one very hard and one easy.*
- *I'd make this event a little longer.*
- *Give more activities that have to do with building things that can help you in your everyday lives.*
- *I would change the event by making time and hands on things for the EXPO.*
- *I would add more experiments.*
- *If I was in charge I would do more exhibits.*
- *I would allow more time to complete the dance pad.*
- *We will learn how to make a video game or movie, cartoon, or a magnet.*
- *I would do more projects that are interesting and fun. But this even was interesting though.*
- *I would improve this by putting more activities in this event.*
- *I would give more challenges.*
- *I would change it by giving more time for each event.*
- *I would have a longer, more organized EXPO time and have the girls get a bigger bag to keep stuff that they made.*

- *I would change it by giving us more time to build.*
- *Well if I was in charge one thing I would change is the amount of time we had to make things.*
- *I would probably bring in more building and architectural activities.*
- *Well, I really liked going into the EXPO, so I would like to have more time in it.*
- *Make more time to explore.*
- *I would have a few more hands-on activities and speakers.*
- *I would give more time to the girls to build or create.*
- *I would have more booths where you could do more things.*
- *I think I would do almost nothing different, but give more time for the second craft.*
- *Not to be so rushed to finish.*
- *If I were in charge I would change the fact that this is only until 3:30. Should be a longer time.*
- *I would have more time for the EXPO or less things at the EXPO.*
- *More time; go to EXPO two times.*
- *Maybe have it spread out over two days.*
- *I would give more time for the harder projects (circuits) and less time for EXPO.*
- *Have more time to wander around the EXPO and more lunch time.*

Some girls made suggestions about ways to improve the way the activities were introduced and carried out:

#### *Activity Difficulty*

- *Go from really easy problems then go slowly to more advanced projects.*
- *Have different projects for different age groups.*
- *I would change it by putting easier hands-on things.*
- *I would change this event by making this dance pad more understandable and more creative.*
- *I would pick out a much easier, less complicated event in place for the dance pad. I would also do more smaller but fun inventions.*
- *Test the activities before you give them to us and make sure they're easy.*
- *Yes, I think the hands on things should have been easier, especially the dance pad.*

#### *Girls' Involvement*

- *After we did the marshmallow experiment and dance pad I would have asked for kid volunteers to come up and share their experiment with everyone.*

- *I would add more choices of how to design things.*
- *I would consider down grading the event by making it more kid friendly or more child led.*
- *I would give ideas and ask for opinions from the girls.*
- *I would give more chance to those who couldn't participate.*
- *I would have a list of projects with similar supplies for people to choose from.*
- *I would make sure everyone had a chance to do it right.*
- *I would make the dance pad creation in such a way that we can design it ourselves.*
- *I would tell them to build anything they can imagine.*
- *I would ask the girls which activity they want to do first and have quicker, shorter activities.*

#### *Detailed Instructions*

- *I would change the event by making the instructions more easier and clearer than before.*
- *I would give more explanation on circuits and how they work (for the dance board).*
- *If I were in charge I would provide more details in instructions on some of the projects.*

#### *Material Quality*

- *Give better materials.*
- *I would ensure the issuing of higher quality materials for the experiments so they could be more successful.*
- *If I were in charge of this event I would have made sure that we had the right tools.*

#### *Activity Implementation*

- *Plan it out on blueprints and get all the supplies and then start.*
- *Make it a bit more exciting. Not having the girls sit down practically the whole time*
- *I would change the fact that everyone's dance pad would have more people and that it would work*
- *I would give the simpler hands on projects, less time, and more difficult projects more times and not having people in groups by last name.*
- *I would work alone.*
- *I would work as a table instead of partners.*

- *If I could change things here and there I would have the girls do activities with 4 people so the helper could help quicker and get to everyone.*
- *If I were in charge I would have smaller groups, more activities, and instruction. Also be able to be in a group with your friends/siblings.*

Some girls made suggestions about ways to improve the event logistics:

#### *Communicating Directions*

- *I would make the groups more organized because many people were confused on where to go.*
- *If I was in charge of this event I would make sure the students understand where to go sit.*
- *I'm not sure because I liked everything except the point where they were putting us in groups. I really got confused.*
- *Make is easier to know where to go, ex. signs.*

#### *Groupings*

- *I would let people choose whether they want to be split into groups because I thought that was a terrible idea to split into groups by last name.*
- *I would let you have some say in who's in your group*
- *I would like to keep troops together.*
- *I would make the kids and parents/adults stay together and not split groups up. That's what really bothered me.*
- *I wouldn't separate the parents from the kids.*
- *Maybe not choose for us but let us pick our own table. Also more activities that we could do at home with things in our home.*
- *Put girls in sections of age.*

#### *Food and Lunch*

- *Have no nuts in the cookies.*
- *I think I would only change lunch choices.*
- *I would change the food time if I were in charge.*
- *I would give snacks.*
- *I would let lunches have the equal amount of food.*
- *I would organize the lunch better and organize the color-coded groups.*
- *If everyone got the lunch they ordered.*

### *Materials*

- *I would get more materials so people don't have to wait as long.*
- *I would give away less random free things (no "take one's" out of the bowl) to cut costs and give more materials for the "build one's"*
- *I would make sure everyone got a t-shirt and a badge holder even if you did come late.*
- *The only thing I would change is having more scissors and tape per table.*
- *Well I would give all the supplies from the video.*

### *General Organization*

- *Better organization before the main event, more stock on bags and shirts (I had to get parent tote and XL t-shirt), easier way to meet with troop sisters after being divided at the conference.*
- *I would change it by having it more organized and having less talking and more experiments.*
- *I would make everyone get in lines instead of grabbing more than one item from each stand because there wasn't enough for everyone.*
- *I would make the EXPO more organized.*

### *Population Served*

- *Add guys - engineering is for everyone.*
- *I would allow boys and girls.*
- *I would only allow about 5 troops and ask about ten engineers to come and make a little robot with each of them.*
- *If I were in charge I would only let Girls Scouts attend. Only cadettes and up levels.*

### *Space Considerations*

- *I would give more space to work.*
- *I would have less girls in here at once.*
- *I would probably get bigger tables for more room. Besides that I would not change a thing.*

### *Volunteer Helpers*

- *I would be nicer because the lady was saying "don't be pigs". I was offended.*
- *I would better inform the staff. I would make where to go, and what table to go to more clear.*

- *I would have volunteers that would stay the whole time instead of leaving early and having 2 groups to monitor.*
- *I would hire more helpers.*
- *I would want more helpers so that we can accomplish our projects faster.*
- *I would want more volunteers so that our projects would work.*
- *Make sure that every group had enough help.*

## Parents and educators

### Characteristics

Parents, educators, troop leaders attended the conference and completed surveys at the end of the day. In total, 226 adults completed surveys. Table 2 summarizes their background characteristics. Similar to girls' characteristics, compared to last year, adults more frequently self-identified as Hispanic, Latino/a, or Spanish (7% last year) and less frequently self-identified as Black or African-American (44% last year).

**Table 2:  
Adults' Background Characteristics**

	<b>Number and Percent</b>
<b>Race/ethnicity (N = 216)</b>	
White or European American	84 (38.9%)
Hispanic, Latino/a, or Spanish	83 (38.4%)
Asian American	39 (18.1%)
Black or African-American	37 (17.1%)
Other (Jewish, Iranian, Armenian, etc.)	8 (3.7%)
Native Hawaiian or Pacific Islander	6 (2.8%)
Native American or Alaskan Native	3 (1.4%)
<b>Relationship to girls attending the event (if any; N = 222)</b>	
Mother	112 (50.5%)
Troop leader	47 (21.2%)
Father	26 (11.7%)
Teacher	25 (11.3%)
Other (aunt, grandparent, tutor, sibling, etc.)	11 (5.0%)
Guardian	1 (0.5%)



	Number and Percent
<b>Professional engineer (N = 221)</b>	
Yes	26 (11.8%)
No (includes engineering students)	195 (88.2%)

## Results

The feedback from adults (engineers and non-engineers alike) who attended the event was very positive. All but two adults reported that they would recommend the *Invent It. Build It.* event to others (99%). Adults rated the event very highly, with all but one adult grading it 'A' (82%) or 'B' (18%).

We asked adults to rate each segment of the event with a grade. Most adults gave 'A' or 'B' ratings to each segment, even when we analyzed the data by removing engineers from the sample and looking only at non-engineers' responses (see Table 3).

**Table 3:**  
**Adults' Event Segment Ratings**

	Number and Percent (All adults, N = 233)	Number and Percent (Non-engineers, n = 195)
<b>EXPO</b>		
A	128 (57.4%)	116 (59.5%)
B	73 (32.7%)	60 (30.8%)
C	17 (7.6%)	13 (6.7%)
D	2 (0.9%)	1 (0.5%)
F	1 (0.5%)	1 (0.5%)
Did not attend	2 (0.9%)	2 (1.0%)
<b>Panel Discussion 1</b>		
A	186 (83.4%)	167 (85.6%)
B	30 (13.5%)	21 (10.8%)
C	4 (1.8%)	2 (1.0%)
D	0 (0.0%)	0 (0.0%)
F	0 (0.0%)	0 (0.0%)
Did not attend	3 (1.4%)	3 (1.5%)

	<b>Number and Percent (All adults, N = 233)</b>	<b>Number and Percent (Non-engineers, n = 195)</b>
<b>How to Do Engineering with Your Students</b>		
A	110 (50.5%)	94 (48.2%)
B	58 (26.6%)	53 (27.2%)
C	3 (1.4%)	3 (1.5%)
D	0 (0.0%)	0 (0.0%)
F	0 (0.0%)	0 (0.0%)
Did not attend	47 (21.6%)	39 (20.0%)
<b>Panel Discussion 2</b>		
A	192 (85.3%)	171 (87.7%)
B	23 (11.6%)	19 (9.7%)
C	6 (2.7%)	4 (2.1%)
D	0 (0.0%)	0 (0.0%)
F	0 (0.0%)	0 (0.0%)
Did not attend	1 (0.4%)	1 (0.5%)

Nearly all the participants, regardless of whether they were engineers, agreed or strongly agreed with the following statements:

- This event helped me learn where to find resources for girls/my daughter (94% of all adults and 92% of non-engineers).
- I feel empowered to help more girls/my daughter become an engineer someday if they want to (93% of all adults and 90% of non-engineers).
- I had fun today (93% of all adults and 92% of non-engineers).
- This event helped me feel well-equipped to talk with girls/my daughter about a career in engineering (92% of all adults and 91% of non-engineers).
- This event taught me some activities I can do with girls/my daughter (92% of all adults and 91% of non-engineers).
- My goals were met today (92% of all adults and 90% of non-engineers).

- This event helped me understand why engineering is a good career choice (90% of all adults, including non-engineers).
- This event helped me understand what engineers do (90% of all adults and 91% of non-engineers, which represents an increase from 81% of all adults last year).
- I had a chance to meet professional engineers today (88% of all adults and 86% of non-engineers, which represents a decrease from 94% of all adults last year).
- This event helped me understand why there are so few women in engineering (79% of all adults and 80% of non-engineers, which represents a decrease from 87% of all adults last year).
- This event helped me to understand what it takes to become an engineer (79% of all adults and 80% of non-engineers, which represents a decrease from 88% of all adults last year).
- All my questions were answered today (74% of all adults and 75% of non-engineers, which represents a decrease from 86% of all adults last year).

We asked adults to report what they learned at the event that they didn't know beforehand. The most popular response was that they learned new information about the field of engineering:

- *All the many and varied fields of engineering. That engineering is difficult to define as it is so all pervasive.*
- *I learned there are many different fields of engineering.*
- *That the world works on engineers.*
- *What the different fields of engineering do; positions/roles of each.*
- *I never thought to think of engineering as a helping profession.*
- *I thought to become an engineer it required 8 years of college.*
- *How much engineers touch so many aspects of daily life.*
- *How engineering is a part of everything from toothpaste to aerospace.*
- *I didn't know make-up companies had engineers. My daughter enjoys make-up.*
- *I learned a chemical engineer is more than just the oil & gas industry.*
- *How to relate every day interests to fields in engineering.*

The next most popular response was that they learned about resources that are available to them:

- *Lots of websites and resources.*
- *I learned about community programs that are specific to girls with interest in STEM (even those related to make-up).*
- *There are a lot of mentoring resources available for girls interested in engineering.*
- *The local camps & programs in the area.*
- *All the different resources out there to help my girls find the right field.*
- *I learned great activities to share with my students.*
- *Websites for supporting girls in STEM.*
- *A lot of resources to help parents prepare their children for engineering.*
- *There are many companies that have outreach programs.*

The next most popular response was that an individual does not need to be a perfect student in order to succeed in engineering:

- *That even average students can be engineers.*
- *You don't need to be great in math and science to be an engineer.*
- *You don't have to excel in math and science to be an engineer. Passion is just as important.*
- *Not all engineers love math.*
- *Girls do not have to be academically at top of their class.*
- *Math and science are not the primary classes to enter engineering fields.*
- *That engineers don't necessarily have to have a mastery/love of math to be successful and accomplish their goals.*
- *I learned that kids don't have to possess a "natural" talent for math and science to become engineers.*
- *that you don't need to be great in math*
- *that you don't have to be good at math to be an engineer*
- *I didn't know that you (my daughter) did not have to be A+ student in math & science to have an engineering career.*

The nearly equally popular response was that they learned about the perspective of female engineers:

- *Greater perspective from women engineers who have been in their field for many years.*
- *Confidence in talking to girls about STEM.*
- *What girls face in college being the only girl.*
- *How to motivate girls to enter the field of engineering.*
- *About the road in the engineering field for women.*
- *The importance of being proactive in my daughter's education and fastening an active role for math and science.*
- *Girls generally have an IQ about 5 points higher than boys.*

- *Better educated on gender bias.*
- *How small the population of women in this field.*

Finally, two adults reported that they learned new information about their daughters and engineering:

- *My daughter learned she really wanted to be a civil engineer.*
- *That my dancer daughter enjoys technical stuff.*

We asked the adults what features they liked most about the event. The most popular response was that adults enjoyed learning from the panelists:

- *The panelists were awesome!*
- *Time to focus and listen away from girls.*
- *Panelist willing to share in depth.*
- *Great speakers! They gave their own experience in real life that could help parents to better help their children to succeed in any career path they choose.*
- *The variety of people and careers in the panel.*
- *I loved the passion with which the panelists spoke about their experiences and I loved the amount of information and resources shared.*
- *The feeling of empowerment I'm given by all the speakers that I can't wait to transfer to my daughter.*
- *The diversity of opinions on both panels. Very informative and helpful*
- *I enjoyed everything but I think what stood out was the panels and the fact that there were not "stuffy" engineers. They were down to earth, real people.*
- *Knowledgeable, engaging, lively speakers.*
- *How intelligently the panels answered the questions. Extremely knowledgeable women and gentleman*
- *Constance Thompson and all the presenters. The different perspectives were priceless.*
- *The speakers were genuine, engaging, and informative. Thank you!*
- *The speakers were incredible! Great array of backgrounds and perspectives!*
- *I really enjoyed having the undergraduate perspective.*
- *Panel interaction especially the ones who shared experiences - not just their job.*
- *I really enjoy listening to successful and articulate women. Constance Thompson was excellent!*
- *Panels were fantastic, strong, smart women.*

- *The panel was very informative. However, instilling confidence in our girls we must also discuss the role of them building their families along with their careers.*
- *Panelists were real people with great experiences and good tips.*
- *Very helpful responses from the panels which encourage us to pursue engineering for our child.*
- *The panels were impressive. Great role models.*

The next most popular response was that adults enjoyed learning about engineering and the resources available to them and that being able to interact with engineers was important to them:

- *The adult time to ask and receive answers.*
- *I got motivated to motivate my daughter more into this field. It also educated me as to how to speak with my daughter about her education.*
- *I think all information provided about resources to help our girls.*
- *Ad-hoc communication/conversations w/ speakers, who all have different experiences to share from engineering field.*
- *All of the different resources offered to parents and educators to help encourage girls.*
- *This event was amazing for me because it opened my eyes to what different types of engineers. It has caused me to be equipped to have an engaged conversation with my kids.*
- *I loved the roving engineers. Having women to talk to made the topic of engineering seem grasp and realistic.*
- *Taught me about my daughter's potential and how I can help her.*
- *I was happy to meet professional engineers*
- *All the interactive info as well as the separate groups for girls/parents.*
- *The secrets of successful engineers. things to do to encourage your child to have passion in the field of engineering*
- *Meeting different professionals with lots of experience.*
- *Seeing woman engineers and getting their personal perspectives about preparing for those jobs (and their encouragement).*
- *I enjoyed learning about the variety of engineering careers. I equally enjoyed hearing about the resources that are available to learn more about them.*
- *The message at getting rid of stereotypes was excellent.*

Finally, adults also reported that they thought the event was well-organized and provided positive, empowering activities for girls:

- *The overall attitudes excited and encouragement were infectious! The friendliness and caliber of the panelists, leaders, and volunteers were tremendous!*
- *Hands-on activities for the girls. The price was amazing! I loved the positive reinforcements for the kids.*
- *The people organization/information and great team. Thank you!*
- *The hands on activities at the EXPO. My daughter's favorite was making the micro bugs with the brushes.*
- *Organized, clean, great information.*
- *Liked the focus on motivating girls by exposure to possibilities.*
- *Informative, non-repetitive and efficient. Engineering made practical and accessible to my girls!*

## Suggestions for Improvement

The most common suggestions from adults were regarding how to better organize the EXPO, the panels, and lunch:

### EXPO

- *Advanced notice of EXPO booths.*
- *Less crowding at EXPO.*
- *We did not know the EXPO was open and available.*
- *EXPO: a bit more space for girls to complete mini projects and space for parents to talk to exhibitors.*
- *The theater is a bad venue, crowded and cramped.*
- *Booths - girls were pushing and not being fair/sharing; booths ran out.*
- *Give attenders tickets to turn in at certain # of exhibits they can attend then they can fill out survey, get more tix, and go to other exhibits to reduce crowding.*

### Panels

- *I would include a section where professionals answer common questions/concerns right off the bat.*
- *For the panel discussions, have people submit questions online and use the questions that most people were interested in. Questions were sometimes too specific.*
- *No tag-alongs - little kids during the discussion for adults.*
- *I would restrict it to age appropriate children and adults. The babies were distracting.*
- *Separate parents from educators. I would have liked more ideas on how to change my class lessons.*

### *Food and Lunch*

- *Put forks in the lunch boxes.*
- *More coffee, tea, & water. Some refreshments or a place to get them during the break prior to lunch.*
- *Do not put coffee set-up at front entrance.*
- *Let parents/educators have lunch with the girls.*
- *Forks/napkins in lunch box.*
- *Lunch arrangement for adults! No space to eat. Very uncomfortable!*
- *Girls & adults should be able to have lunch together.*
- *Better lines for the food.*
- *I would only add a gluten free option for lunch.*
- *Lunch: better explain meal choices (if someone asks for turkey, please don't include bacon on it).*
- *Let girls pick where to sit; mine came with friends and they separated them so she didn't have as much fun.*

### *Population Served*

- *Open this up to junior GS and up.*
- *Lower the age. Make it for girls 7 and up to high school.*
- *I would include all levels of Girl Scouts, that is Brownie-Senior.*

Many others made requests for more interaction and hands-on activities:

- *Offer more interaction with the girls.*
- *Smaller workshops for adults.*
- *Small group interaction with engineers may be interesting.*
- *Small group discussions.*
- *Break out into smaller groups.*
- *Have my daughter to talk more to student or young engineers on a one to one basis.*
- *Panel discussion for girls.*
- *Have women engineers during lunch, have mini-discussions for parents.*
- *Hands-on activities for parent, i.e., try and fail.*
- *Short hands-on with adults.*
- *More booths at the EXPO and hands on activities for parents and educators.*
- *More hands on for the adults. Possibly how to do projects with girls.*
- *Greater variety of hands-on demonstrations.*
- *Some activities for adults, to see how challenging things can be for daughters.*



- *I would have more vendors in the EXPO. The EXPO seemed to have a lot of robotics exhibitors but not as many other areas represented.*
- *Have smaller break-out group and sections based on age and interest.*

Some adults made suggestions that were logistical in nature. For example, some adults made suggestions regarding timing:

- *Allow more time for panelists to present apart from Q & A*
- *Lunch earlier. More time to do hands on after program.*
- *Make it longer!*
- *More time in the exhibition - but don't take away from the panel.*
- *I would like more time for questions.*
- *Multiple days. Lots to take in all at once.*
- *More time to view exhibits and talk with students.*
- *Shorter panel introductions - 30 minutes for intros is too long.*

Some adults requested additional information:

- *More chemical engineering info/activities.*
- *Maybe talk a bit more about university requirements for science-related HS classes.*
- *More info in packets i.e. list of engineer disciplines, typical careers/companies for engineers.*
- *A few specific examples of "day in the life of" engineers.*
- *Add more information about the path of preparation necessary - starting in elementary school.*
- *No change other than making sure that being feminine or "girly" is not looked down on. It's ok to be a feminine girl.*
- *Talk about cost of becoming an engineer.*
- *Maybe more information on how to pay for school.*
- *More emphasis on the other parts of STEM other than engineering.*
- *Strand for bilingual parents; strand for senior high-focused on colleges.*
- *Talks that are "case studies" of successful women experiences.*
- *Add to the panels educators; my experience is that there are biases in the educators more than from parent engagement.*
- *More of the other engineering disciplines like chemical in the hands-on area.*
- *More diversity of engineering disciplines on display.*

A few adults suggested that the registration process, material supplies, and volunteer communication needed improvement:

- *Better check-in. We were in line for 30 minutes despite pre-registration.*

- *Availability to sign up and time for programs available.*
- *Make sure that there are enough t-shirts and lunches for registered guests.*
- *Enough totes for participants! Maybe give them as you check in as all 4 of my girls did not get a tote and I had registered online.*
- *Assign backpack and shirts to people to avoid running out. Seemed disorganized.*
- *Have enough backpacks for all the girls who registered.*
- *Have enough handouts, materials for all.*
- *More help in giving direction in the morning. Lots of volunteers. Everyone in groups not asking if they can help. They were just standing and chatting.*
- *Better information as you arrive regarding schedule for the day.*
- *The volunteers need more information. I got a lot of misinformation about where to be and when.*
- *I would have more people outside giving directions.*
- *More organized way to turn in surveys.*

## EXPO participants

### Characteristics

For the first time this year, SWE surveyed participants as they left the EXPO. In total, 39 participants completed surveys. Table 3 summarizes their background characteristics.

**Table 3:  
EXPO Participants' Background Characteristics**

	Number and Percent
<b>Gender (N = 38)</b>	
Female	34 (89.5%)
Male	4 (10.5%)
<b>Race/ethnicity (N = 39)</b>	
White or European American	17 (43.6%)
Hispanic, Latino/a, or Spanish	8 (20.5%)
Asian American	6 (15.4%)
Black or African-American	5 (12.8%)
Other (Sri Lankan, etc.)	3 (7.7%)

	Number and Percent
<b>SWE Member (N = 38)</b>	
Yes	16 (42.1%)
No (includes engineering students)	22 (57.9%)

## Results

Participants rated the EXPO very highly, grading it 'A' (63%) or 'B' (37%). Nearly all participants agreed that they know how to connect to valuable resources that they didn't know about before attending the EXPO (95%).

We asked participants what they liked most about the EXPO. More than half (62%) mentioned the hands-on activities. More than a quarter (28%) mentioned the information and outreach offered to participants. Participants reported that they also appreciated the opportunity to be exposed to other organizations and programs as well as the excitement of the participants (23%).

## Suggestions for Improvement

We asked participants how they would change the EXPO for the future. Nearly one-third of participants (30%) reported that they would increase the advertising and/or the involvement of organizations in the EXPO:

- *Many booths were empty. Advertise to [organizations] who are interested in outreach.*
- *I would like to see more booths (companies) involved geared (inspiring) towards kids.*
- *Add more corporate sponsors.*
- *More vendor involvement.*

Some participants noted areas for logistic improvement:

- *Split the SWE girls in 2 groups. 1 group goes through the exhibit for 1 hour while the other half goes upstairs to the speakers. Then they switch.*
- *More time for adults to learn to do the projects with the girls.*
- *More space between booths & under aisles. Places for adults to sit & charge phones.*
- *More defined child drop off/ pick up arrangements.*

Finally, some participants suggested more activities and/or resources:

- *More hands-on for the children.*

- *More experiments at each stage.*
- *Let parents/teachers build too!*
- *Ability to have a kit for all projects even if for purchase.*
- *More resources for sections to develop their own programs.*

# **Appendix A: Schedule of Events and Activities**

## Schedule for Girls

9:00—10:45	<b>Sign In Open—</b>  <b>Invent It. Build It Outreach Expo</b> open to registered participants only (Girls and PEP)
10:45-11:00	Transition of participants (Girls and PEP) into their rooms
11:00	Welcome from GSUSA (introduce Deysi)
11:05	DSN Video and Introduction of Deysi
11:10	1 <sup>st</sup> activity: Touchdown
12:10—12:50	LUNCH
12:50 -1:00	Keynote
1:00	2 <sup>nd</sup> activity: Dance Pad Mania
2:30	Evaluations
2:45	Welcome Parents and sharing
3:00	Presentation of banner to ExxonMobil Foundation
3:05	ExxonMobil Closing Remarks
3:10	Raffles/Give Aways
3:30	Dismissal – goody bags in exchange for evaluations

## Schedule for Parents and Educators

Invent It. Build It. Event  
SWE, GSUSA, WGBH  
October 25, 2014  
Los Angeles, CA

- |               |   |
|---------------|---|
| 9:00 – 10:45  | Sign-In and Expo open   |
| 10:00 -10:45  | High School Panel <ul style="list-style-type: none"><li>• Dot Harris</li><li>• Euridice Oware</li><li>• Beth Holloway</li><li>• Rajani Bansal</li></ul>   |
| 10:45 – 10:55 | Transition to PEP room / coffee break   |
| 10:55 – 11:00 | <b>Welcome and Partner introductions</b>  |
| 11:00 – 11:15 | Techbridge Ice Breaker  |
| 11:15 – 12:00 | <b>Panel Discussion 1: Why Engineering?</b> <ul style="list-style-type: none"><li>• <b>Dot Harris</b></li><li>• <b>Euridice Oware</b></li><li>• <b>Luz Rivas</b></li><li>• <b>Teresa Baumrucker</b></li><li>• <b>Lyn Repath-Martos</b></li><li>• <b>Beth Holloway</b></li></ul> |
| 12:00 – 12:40 | <b>Flex Time</b> <ul style="list-style-type: none"><li>▪ <b>EXPO</b></li><li>▪ <b>How to do engineering with your students Workshop (Techbridge)</b></li></ul>  |
| 12:40 – 1:30  | <b>Lunch</b>  |
| 1:30 – 2:30   | <b>Panel Discussion 2: Preparing for Engineering Success</b> <ul style="list-style-type: none"><li>• <b>Constance Thompson</b></li><li>• <b>Rajani Bansal</b></li><li>• <b>Amy Kim</b></li><li>• <b>Mary Haggerty</b></li><li>• <b>Debra Kimberling</b></li></ul>               |

- **Carla Proulx**

2:30 – 2:45

**Evaluations**

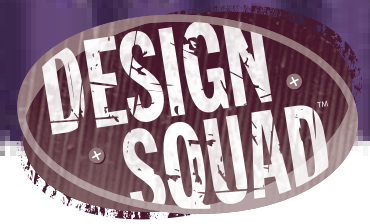
2:45 – 3:30

Parent Educators Join the Girls



## Appendix B: Activity Sheets

# DANCE PAD MANIA



## YOUR CHALLENGE

Build a dance pad that lets you use your feet to sound a buzzer or flash a light.

## MATERIALS\*

- 1.5-volt AA battery
- AA battery holder (optional)
- Aluminum foil
- Bulb holders for light bulbs (enough for half the group)
- Buzzers (enough for half the group)
- 2 11 x 17-inch sheets of corrugated cardboard (per team)
- Duct tape
- Electrical wire (22-gauge works well)
- Light bulbs that can run on a 1.5-volt AA battery
- Plastic wrap
- Scissors
- Wire strippers

\* For information on where to get these materials, see page 6 or visit [pbskids.org/designsquad/engineers](http://pbskids.org/designsquad/engineers).

## BRAINSTORM AND DESIGN

Divide your group into teams of two. Half the teams will make floor pads that flash a light, and the other half will make floor pads that sound a buzzer. When you work as a team, you can often solve design challenges more quickly. For example, you can share knowledge, get new ideas, and brainstorm solutions to problems. You can also learn a lot by looking at how other teams made their pads and seeing how they solved problems.

Your dance pad is basically a super-sized version of the alarm you built in Challenge 1. Like Hidden Alarm, the dance pad has a power source (the battery), materials for conducting electricity (the wires and foil), and something that uses the electricity (the buzzer or light). Yup, that's right, it's an electrical circuit. Before you begin designing, brainstorm answers to the following questions and record your ideas in your design notebook.

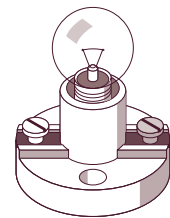
- Will my pad turn on a buzzer or a light?
- How will I build a switch into my pad to turn the buzzer or light on and off?
- How big will my pad be?
- How can I make it sturdy enough to withstand constant stomping?
- Where will I put the battery? Inside the pad? Outside the pad?

## BUILD, TEST, AND REDESIGN

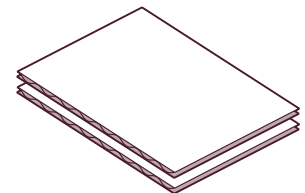
As you build, make sure the circuit works and that it will be able to stand up to some rugged treatment! Once you've built your pad, test it. Step on it several times in a row to turn the buzzer or light on and off. How well did it work? When we made ours, we had to debug some problems. For example, our wires sometimes got loose and our pad stopped working. Also, our switch didn't always work. If things like this happen to you, figure out a way to fix the problem so that your pad works every time.



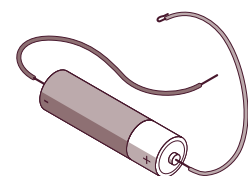
Buzzer



Light bulb and bulb holder



Corrugated cardboard



1.5-volt AA battery

# DANCE PAD MANIA

## TAKE IT TO THE NEXT LEVEL

- Make a pad that has both a light and a buzzer.
- Make a pad that uses two batteries, two lights, or two buzzers.

### INSIDE THE ENGINEERING

#### TECHNO GYM

Bust a move! Break it on down and get a good workout at Overtime Fitness™, a revolutionary fitness arcade for teens. Forget what you know about gyms, this is the gym of the future. Get your heart pumping with *In the Groove 2*®, a dance game that works like *Cyber Groove*™, *Dance Dance Revolution*®, *Feet of Fury*™, and “*Pump it Up*”®. Just try keeping up with those moving arrows! How about putting your one-two punch to the test with *MoCap Boxing*®, a virtual game complete with boxing gloves, a 3D virtual opponent, and infrared sensors that track your movements? Or try a game that has you jump, duck, and lunge to avoid virtual dodge balls. You can even hook yourself up to a video game box and become a human joystick to move an on-screen player. Note: The sensors, computers, sound systems, and software that make these games work were all brought to you by engineers. What will those ingenious engineers come up with next!?

Overtime Fitness is a trademark of Overtime Fitness, Inc. In the Groove is a registered trademark of Konami Digital Entertainment Co., Ltd. Cyber Groove is a trademark of Front Fareast Industrial Corp. Dance Dance Revolution is a registered trademark of Konami Digital Entertainment Co., Ltd. Feet of Fury is a trademark of Cryptic Allusion Games. “Pump it Up” is a registered trademark of Andamiro U.S.A. Corp. MoCap Boxing is a registered trademark of Konami Corporation

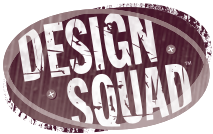
## TAKE IT ONLINE

Want something electrifying? Build a switch and wire up some different kinds of circuits! Download *Turn It On and Off* from Intel’s *Design and Discovery* hands-on engineering program.

➤ [intel.com/education/designanddiscovery](http://intel.com/education/designanddiscovery)



The *Design Squad* cast moves and grooves. They built a floor sensor that used thin foam and metal to make switches that turned sound clips on as they danced.



Watch *Design Squad* on PBS (check local listings). Download more challenges at [pbskidsgo.org/designsquad](http://pbskidsgo.org/designsquad).



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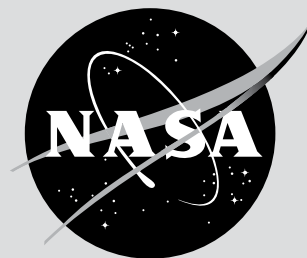


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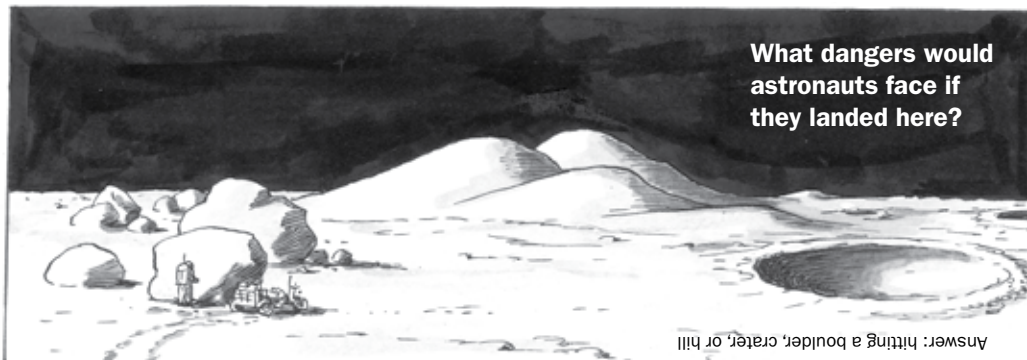


# TOUCHDOWN



as built on TV

Landing on the moon is tricky. First, since a spacecraft can go as fast as 18,000 miles per hour (29,000 km/hour) on its way to the moon, it needs to slow way down. Then it needs to land gently. That lander has astronauts inside, not crash-test dummies. Easy does it!



## WE CHALLENGE YOU TO...

...design and build a shock-absorbing system that will protect two "astronauts" when they land.

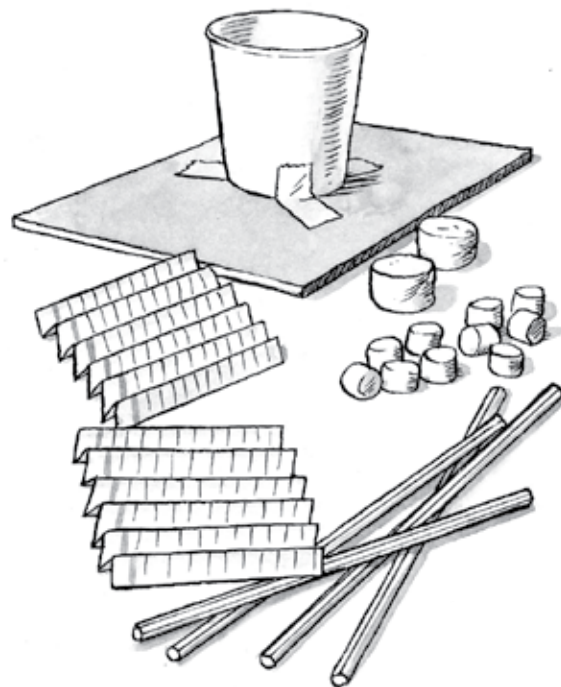
## BRAINSTORM AND DESIGN

Think about how to build a spacecraft that can absorb the shock of a landing.

- What kind of shock absorber can you make from these materials that can help soften a landing?
- How will you make sure the lander doesn't tip over as it falls through the air?

## BUILD

- 1. First, design a shock-absorbing system.**  
Think springs and cushions.
- 2. Then, put your spacecraft together.**  
Attach the shock absorbers to the cardboard platform.
- 3. Finally, add a cabin for the astronauts.**  
Tape the cup to the platform. Put two astronauts (the large marshmallows) in it. (NOTE: The cup has to stay open—no lids!)



A lander under construction

## MATERIALS (per lander)

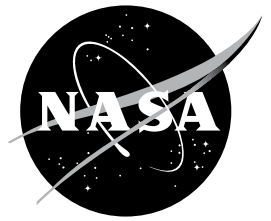
- 1 piece of stiff paper or cardboard (approximately 4 x 5 in/10 x 13 cm)
- 1 small paper or plastic cup
- 3 index cards (3 x 5 in/8 x 13 cm)
- 2 regular marshmallows
- 10 miniature marshmallows
- 3 rubber bands
- 8 plastic straws
- scissors
- tape



## TEST, EVALUATE, AND REDESIGN

Ready to test? Drop your lander from a height of one foot (30 cm). If the “astronauts” bounce out, figure out ways to improve your design. Study any problems and redesign. For example, if your spacecraft:

- **tips over as it falls through the air**—Make sure it’s level when you release it. Also check that the cup is centered on the cardboard. Finally, check that the weight is evenly distributed.
- **bounces the astronauts out of the cup**—Add soft pads or change the number or position of the shock absorbers. Also, make the springs less springy so they don’t bounce the astronauts out.



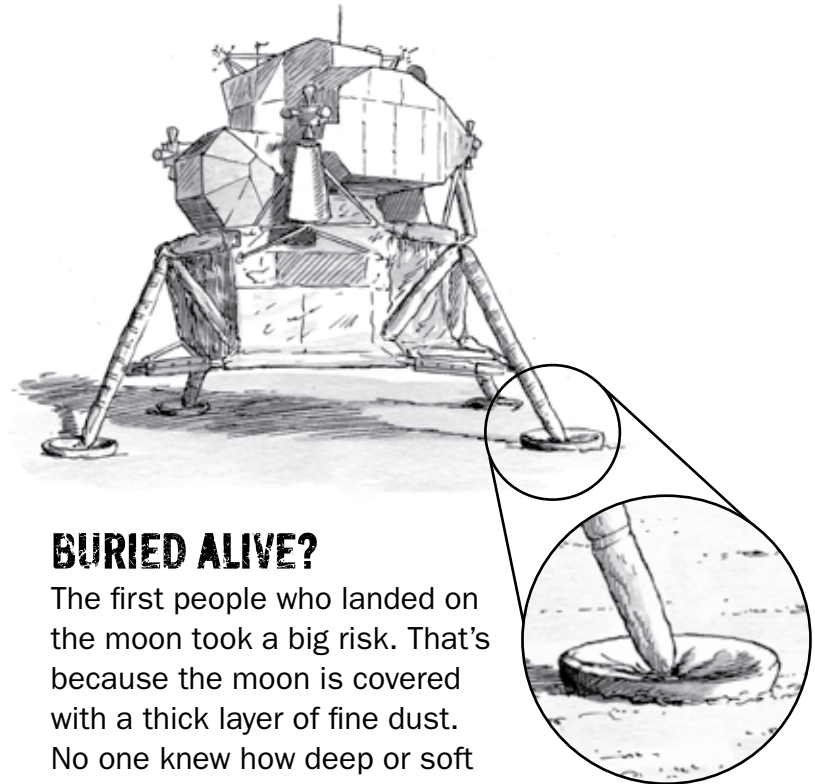
Check out NASA's moon missions at [moon.msfc.nasa.gov](http://moon.msfc.nasa.gov).



### THE COOLEST JOB AT NASA

When people asked Cathy Peddie what she wanted to do when she grew up, she would point at

the sky and say, “I want to work up there!” Now an engineer at NASA, she manages the Lunar Reconnaissance Orbiter (LRO) project. She calls it “the coolest job at NASA.” LRO will orbit the moon for at least a year and collect information to help NASA prepare for having people live and work there. Hear her describe the mission at: [learners.gsfc.nasa.gov/mediaviewer/LRO](http://learners.gsfc.nasa.gov/mediaviewer/LRO).



### BURIED ALIVE?

The first people who landed on the moon took a big risk. That’s because the moon is covered with a thick layer of fine dust. No one knew how deep or soft this layer was. Would a spacecraft sink out of sight when it landed? Now we know—the layer is firm. In the picture, you can see that Apollo 11’s lander pads sank only about 2 inches (5 cm) into the dust. What a relief! This helped NASA figure out the kinds of shock absorbers and landing systems its spacecraft need.

Only 12 people have ever visited the moon. But someday soon NASA plans to have teams of astronauts living there for six months at a time.



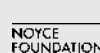
Watch **DESIGN SQUAD** on PBS or online at [pbs.org/designsquad](http://pbs.org/designsquad).



Major funding for *Design Squad* provided by



Additional funding for *Design Squad* provided by



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For more information about NASA missions and educational programs, visit [nasa.gov](http://nasa.gov).

## Appendix C: Survey Instruments

**Invent It. Build It. – Student Feedback Form**

**Thank you for your participation. Please take a few minutes to fill out this survey.**

Your comments and ideas will help make this event better in the future.

**If you have questions, please ask a volunteer.**

1. What grade would you give today’s event? Please circle the letter to show your answer.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>F</b>
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2. What did you like most about the event today?

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3. Please tell us how much you agree with the following statements about today’s event.  
Please check the box to show your answer.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
<b>Before</b> this event, I knew what an engineer did.					
<b>After</b> this event, I know what an engineer does.					
<b>Before</b> this event, I was interested in becoming an engineer.					
<b>After</b> this event, I am interested in becoming an engineer.					
I see a connection between my interests/passions and engineering.					
I worked with a mentor who was helpful and easy to talk to.					
I enjoyed the fact that this was an event just for girls.					
I know how to find out more about engineering if I want to.					
I know my friends would support my interest in engineering.					

4. Think back on your day, look at the following items, and check the box that best completes the sentence.

	<b>Improved</b>	<b>Stayed the Same</b>	<b>Got Worse</b>	<b>I Don't Know</b>
My confidence in problem-solving...				
My confidence in building and designing things...				
My ability to brainstorm solutions to problems...				
My ability to think of many different possible ways to solve a problem...				
My ability to use the design process (brainstorm, design, build, test, redesign)...				

5. Please tell us how much you agree with the following statements. Please check the box to show your answer.

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Not Sure</b>	<b>Agree</b>	<b>Strongly Agree</b>
Engineers are innovative. (They come up with new ideas and inventions.)					
Engineers are creative.					
Engineers do work that is hands-on.					
Engineers do work that is fun.					
Engineers do work that allows them to help their community and/or society.					
Engineers work in many different kinds of career fields.					
Engineering is a good career choice for women.					

6. If you were in charge, how would you change this event?

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7. Would you recommend that other kids participate in events like this?
- a. Yes
  - b. Maybe
  - c. No (please explain): \_\_\_\_\_
8. How old are you? \_\_\_\_\_
9. With what races or ethnicities do you most identify?  
(Choose all that apply. This question is optional.)
- a. White or European American
  - b. Hispanic, Latino, or Spanish
  - c. Black or African-American
  - d. Asian American
  - e. Native Hawaiian or Pacific Islander
  - f. Native American or Alaskan Native
  - g. Other: \_\_\_\_\_
10. Are you more interested in being involved with the Girl Scouts after attending this event?
- a. Yes
  - b. No
  - c. Maybe
  - d. I am already a Girl Scout

**Thanks very much for your help! Please hand in your completed survey.**

**Invent It. Build It. – Adult Participant Feedback Form**

**Thank you for your participation. Please take a few minutes to fill out this survey.**  
Your comments and ideas will help make this event better in the future.

1. What grade would you give today’s event? Please circle the letter to show your answer.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>F</b>
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2. What did you like most about the event today?

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3. Please check the boxes below to indicate how much you agree with each statement.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
This event helped me feel well-equipped to talk with girls/my daughter about a career in engineering.					
This event helped me understand what engineers do.					
This event helped me understand why engineering is a good career choice.					
This event helped me understand what it takes to become an engineer.					
This event helped me understand why there are so few women in engineering.					
This event taught me some activities I can do with girls/my daughter.					
This event helped me learn where to find resources for girls/my daughter.					
I had a chance to meet professional engineers today.					
All my questions were answered today.					
My goals were met today.					
I feel empowered to help girls/my daughter become an engineer someday if they want to.					
I had fun today.					

4. What did you learn that you didn't know before today's event?

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5. How would you change this event for the future?

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6. Please rate each segment of today's event by circling a letter grade. Add any comments you have.

<b>Expo</b>	A	B	C	D	F	Did not attend
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Comments: \_\_\_\_\_

<b>Panel Discussion 1: Why Engineering?</b>	A	B	C	D	F	Did not attend
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Comments: \_\_\_\_\_

<b>How to Do Engineering with Your Students Workshop</b>	A	B	C	D	F	Did not attend
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Comments: \_\_\_\_\_

<b>Panel Discussion 2: Preparing for Engineering Success</b>	A	B	C	D	F	Did not attend
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Comments: \_\_\_\_\_

7. Would you recommend that others participate in events like this?
- a. Yes
  - b. Maybe
  - c. No (please explain): \_\_\_\_\_
8. What is your relationship to the girl(s) participating in the event today?
- a. Mother
  - b. Father
  - c. Guardian
  - d. Troop Leader
  - e. Teacher
  - f. Other \_\_\_\_\_
9. With what races or ethnicities do you most identify? (Choose all that apply. This question is optional.)
- a. White or European American
  - b. Hispanic, Latino, or Spanish
  - c. Black or African-American
  - d. Asian American
  - e. Native Hawaiian or Pacific Islander
  - f. Native American or Alaskan Native
  - g. Other: \_\_\_\_\_
10. Are you an engineer or do you have an engineering degree?
- a. Yes
  - b. No

**Thanks very much for your help!**

**Please hand in your completed survey. Stay in touch with SWE at [www.swe.org](http://www.swe.org).**

**Invent It. Build It. – Expo Participant Feedback Form**

**Thank you for your participation. Please take a few minutes to fill out this survey.**  
Your comments and ideas will help make this event better in the future.

1. What grade would you give **the Expo**? Please circle the letter to show your answer.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>F</b>
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2. What did you like most about the Expo?

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3. How would you change the Expo for the future?

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4. I know how to connect to valuable resources that I didn't know about before attending the Expo.

- a. Yes
- b. No

Comments: \_\_\_\_\_

5. I am:

- a. Male
- b. Female

6. With what races or ethnicities do you most identify? (Choose all that apply. This question is optional.)

- a. White or European American
- b. Hispanic, Latino, or Spanish
- c. Black or African-American
- d. Asian American
- e. Native Hawaiian or Pacific Islander
- f. Native American or Alaskan Native
- g. Other: \_\_\_\_\_

7. Are you a member of the Society of Women Engineers?

- a. Yes
- b. No

**Thank you very much for your help!**