Engineering Interest and Attitude Development In Out-of-School Time

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Abstract

Since its inclusion in the Next Generation Science Standards (NGSS), engineering has continued to emerge in classrooms and informal settings. As educators become familiar with this discipline, there is opportunity for research to inform our understanding of how youth are relating to engineering concepts and practices. This paper examines how engaging with engineering in out-of-school-time (OST) settings impacts youths' interests and attitudes toward engineering. Data are drawn from four OST sites that implemented a hands-on engineering curriculum with 52 middle-school-aged youth. Quantitative analysis of survey data indicate that exposure to engineering activities has a significant effect on youth's engineering attitudes. Qualitative analysis of video data, using event maps and discourse analysis, suggests why and how youths' attitudes may change. This study advances the field's understanding of how engineering interest and affiliation may be developed among middle-school-age youth in informal learning environments. Implications for educators and curriculum developers are discussed.

Introduction

Economists and industry leaders agree, the future is looking bright for most engineering professions. Through 2026, the Bureau of Labor Statistics projects engineering jobs, in aggregate, will grow at a faster rate than the average for all industries [1]. Unfortunately, there are not enough graduates to meet this need, and among those that do enter the engineering pipeline, there continues to be a pervasive gender and diversity gap [2]. However, the following developments suggest things are moving in the right direction: With the inclusion of engineering in the Next Generation Science Standards [3], a greater number of students are being exposed to engineering in school. Engineering is now more prevalent in early childhood settings thanks to a growing body of research that shows it's never too early to begin teaching engineering [4]. And out-of-school-time (OST) programs, which serve large numbers of minority youth, have also expanded their offerings in recent years [5].

With increased prominence in both formal and informal education settings, it stands to reason that more young people will interact with engineering, develop an interest, and eventually enter the pipeline. However, there is a dearth of research into the mechanics of this process, and consequently, we have a limited understanding of how interest and affiliation are developed, particularly in the OST setting. This has implications for educators and curriculum developers who are charged with not only engaging and piquing interest, but with creating activities and learning environments that appeal to *all* students, including those who are under-represented in the STEM fields.

Research Question

In this study, we examine surveys, youth focus groups, and over 100 hours of video footage, with the goal of understanding how youths' interests and attitudes toward engineering develop in out-of-school-time environments.

Our research questions are as follows:

- What engineering practices or *habits of mind* (HoM) emerge as OST youth engage in engineering activities?
- How do these HoMs impact youth's interests and attitudes toward engineering?

Methods

Site Selection

With a goal of understanding the development of youth attitudes toward engineering in the OST setting, we began recruiting OST programs into the study. A limited budget required that we cap recruitment at four sites; however, we wanted these sites to represent both school-affiliated and non-school-affiliated programs from urban, suburban, and rural locations. We chose two sites in Arizona—one at a community-based summer camp in Flagstaff and one at a middle school afterschool program on Diné or Navajo tribal lands. We also chose two sites in Massachusetts—one at a private middle school afterschool program in Lowell, and one at a public middle school afterschool program in Winthrop. See Table 1 for more information about these sites.

Table 1. Data collection sites

Site	Location	Urban Rural Suburban?	School-Affiliated?	% of Youth Receiving FRL	Unit Taught	Number of Youth Enrolled
Community-based summer camp	Flagstaff, AZ	Urban	No	61	Water Resource	17
Navajo public middle school afterschool	Tuba City, AZ	Rural	Yes	100	Remote Sensing	15
Private middle school afterschool	Lowell, MA	Suburban	Yes	7	Water Resource	10
Public middle school afterschool	Winthrop, MA	Suburban	Yes	36	Remote Sensing	10

Once formally recruited into the study, site educators received all supplies needed to teach an eight-part *Engineering Everywhere* unit to middle-school-age youth. This consisted of the educator's guide, a set of engineering journals, and a materials kit. While teaching schedules varied across sites, most taught the activities on a weekly basis, taking roughly 8-10 weeks to finish. Site educators were also asked to play a supportive role in recruiting a group of age-appropriate youth and encouraging them to attend consistently across the eight activities. For these efforts, they were provided a $500 stipend.

Study Participants

Across the four sites, a total of four educators led sessions for 52 middle-school-age youth. Although site educators encouraged them to attend consistently, youth participation in the activities was optional. This is typical of the informal learning environment, where youth generally have the freedom to choose their level of involvement. While this created some inconsistency in attendance, it allowed us to explore the development of their engineering attitudes in a typical OST setting. Of the 52 youth enrolled, 81% (42 youth) attended at least five of the eight activities. Participants spanned a range of demographic groups from rural, urban, and suburban areas. While some of the participants had previous experience with engineering, either in school or in the OST setting, none of the participants had experience with the engineering activities used in this study. See Table 2 for a breakdown of participant demographics.

Table 2. Participants attending at least five of the eight activities

%Male	%Female	%Under-represented minority	#Total
47	53	51	42

Engineering Curriculum

Sites were assigned one of two hands-on EiE engineering units: *Testing the Waters: Engineering a Water Reuse Process* (water resource engineering) or *Worlds Apart: Engineering Remote Sensing Devices* (remote sensing engineering). Both were developed with NASA funding by the EiE project in collaboration with curriculum development professionals from Northern Arizona University and scientists from the United States Geological Survey. Both were developed specifically for middle-school-age youth in the OST setting. EiE units are grounded in a sociocultural perspective on learning which assumes that as youth work collaboratively with peers and educators, they begin to develop fluency in the epistemic practices of engineering [6]. These epistemic practices, or habits of mind, are an important part of this research. Once identified, they provide opportunities for researchers to look for connections between the discursive and behavioral actions of youth, and the development of engineering attitudes and affiliation [7]

Both units contain eight 60-minute activities, intended to be taught sequentially to youth arranged into groups of 3-4. They assume no prior experience with engineering; therefore, the units begin with a set of “prep activities” that establish a common understanding of engineering and technology among participating youth. The subsequent six activities build upon each other, following steps of the engineering design process: youth learn about a problem, explore available materials, plan a design, create and test it, improve it, and finally, groups share their designs in a whole-group “showcase” activity. See Table 3 for a detailed unit map.

Table 3. Overview of unit activities

Activity	Remote Sensing Unit	Water Resource Unit
Prep 1	Youth are introduced to the Engineering Design Process as they work together to engineer a tower to support a model antenna	Youth are introduced to the Engineering Design Process as they work together to engineer a tower to support a model water tank

Prep 2	Youth match technologies based on the problem they solve and imagine ways to improve the newer version	Youth will play a quiz game to define the "technology" and learn that engineers design technologies to solve problems
Activity 1	Youth use mirrors to change the way light travels in order to see hidden objects	Youth investigate how using water for various tasks can impact the water's quality
Activity 2	Youth explore how manipulating light and color can help them interpret information from a distance that would otherwise be difficult to see	Youth investigate the properties of filter materials and create their own water filters to remove or treat contaminants from a water sample
Activity 3	Youth engineer a technology that models LiDAR to gather topographical information about the features of a surface	Youth apply what they learned about filters and water quality to re-pipe a model house to reuse as much water as possible
Activity 4	Youth work in groups to create remote sensing technologies that can collect data about a Mystery Moon	Youth work in groups to plan, create, and test their water reuse processes designed for an extreme environment scenario
Activity 5	Youth will improve their remote sensing devices and use them to take a final reading from two locations on a Mystery Moon	Youth work in groups to improve their water reuse process to better meet the criteria in their extreme environment
Activity 6	Youth communicate their knowledge of remote sensing devices and the information they gathered about the Mystery Moon at the Engineering Showcase	Youth communicate their ideas about designing a water reuse process in the Engineering Showcase

Data Collection

To explore the nuances of interest and attitude development among middle-school-age youth, we used a mixed methods approach. Data collection included video and audio recording, youth surveys, youth focus groups, and youth engineering journals. The research team, which includes the authors, collected video and audio data. At each of the four sites, data were collected from two groups of 3-4 youth for all eight activities. In accordance with our IRB, and in collaboration with the Diné (Navajo) HRRB, we collected parent/guardian consent, as well as youth assent. The data collection resulted in an archive of 68 hours of video footage that capture groups of youth progressing through all eight engineering activities in the unit. A third, wide-angle camera at each site recorded the educator leading the whole group through all eight activities, adding another 29 hours of footage. For the purposes of this study, these video data proved indispensable, allowing us to observe and analyze the interactions and behaviors of the youth as they navigated through their engineering successes and failures.

The eight groups of youth captured on video were also asked to participate in a brief focus group at the conclusion of their final activity. Having spent considerable time working together, we asked participants to reflect as a group on their engineering experiences. Researchers facilitated the focus groups and captured them on video. These conversations shed light on youths' perceptions of their engineering work, and their thoughts about engineering as a possible career choice.

A survey of youths' engineering interests and attitudes (EIA) was also completed by 37 youth at the conclusion of the final activity (See Appendix A) to measure these attributes quantitatively. We used a 19-item post-only Likert-scale survey. Youth answered each item twice: first with the prompt, "Last summer, I would have said" (PRE) then with the prompt, "Now I would say" (NOW). This retrospective pre-post survey was chosen because prior research by the authors [6] showed that until youth engage in engineering, they are likely to know very little about it. A pre-test, therefore, does not yield valid data. See Table 4 for a listing of scales and items.

Table 4. EIA items in scales

Item#	Scale	Text of item from the instrument
8	Enjoyment	Engineering is fun
13	Enjoyment	I am interested when we do engineering
23	Enjoyment	Engineering is easy for me
3	Enjoyment	I enjoy studying engineering
1	Value to me	It is important for me to understand engineering
2	Value to me	Engineering helps me understand today's world
6	School	We learn about interesting things when we do engineering
9	School	When we do engineering, we use a lot of interesting materials & tools
22	School	We learn about important things when we do engineering
25	School	I try hard to do well in engineering
14	Value to society	Engineers help make people's lives better
17	Value to society	I know what engineers do for their jobs
21	Value to society	Engineering is useful in helping to solve the problems of everyday life
24	Value to society	Engineering is really important for my country
10	Value to society	It is important to understand engineering in order to get a good job
30	Aspirations	I really want to learn engineering
18	Aspirations	I would enjoy being an engineer when I grow up
26	Aspirations	I would like to learn more about engineering

5	Aspirations	I would like to work with other engineers to solve engineering problems

Development of the EIA was informed by the work of earlier researchers interested in measuring science interests and attitudes among middle and high school students [8], [9], [10], [11]. An engineering version was first developed by the authors in 2010 [12]. Multiple iterations followed. The version used in this study was adapted for OST use [6].

Analysis

Scaled scores for the EIA were calculated from the student survey data using the factor score coefficients for the NOW scores [6]. Seven missing item scores were imputed using IVEware [13]. We standardized each item on the EIA survey by subtracting the overall mean (PRE and NOW) from the student's item rating and dividing by the standard deviation. We then multiplied by the coefficient for the item for that factor to calculate each individual's factor score per item, and summed the item-factor scores to create PRE and NOW scores for five factors: Enjoyment, Value to me, School, Value to society, and Aspirations. See Table 5 for factor determinacies. To compare NOW to PRE scores for significant differences, we ran a paired-samples t-test in SPSS 25 [14].

Because of the relatively small number of EIA survey completers (37), we did not segment EIA data by gender, under-represented minority status, or site location. While we acknowledge the importance of understanding gender and minority disparities in STEM, we simply did not have the numbers in this study to conduct a meaningful analysis on this topic.

Table 5. Factor determinacies

	Enjoyment	Value to me	School	Value to society	Aspirations
PRE	0.934	0.865	0.918	0.908	0.908
NOW	0.939	0.839	0.917	0.873	0.936

Focus group data were analyzed using thematic analysis [15] in which youth responses to questions (See Appendix B for the Focus Group Discussion Guide) were transcribed and coded using our research questions as an interpretive lens. Codes were then grouped thematically and consolidated.

We used a sociocultural approach to discourse analysis to analyze the video data. Our analysis drew from prior research that investigated student engineering identity and attitude development in formal classroom settings [16]. Despite this being in OST, we understand that engineering interest and attitude development is fostered through engagement with engineering activities and social interaction with peers. Therefore, we began by searching the video and identifying the activities where youth were both highly engaged and highly communicative with one another. We identified activities four, five and six, as productive places for analysis because across units and sites, youth are creating, testing, improving and communicating what they've learned. Refer back to Table 3 for a more detailed description of these activities.

Focusing on activities four through six, we began creating event maps in a process informed by [16]. After mapping the timeline, we identified instances where youth seemed to be employing certain practices or engineering *habits of mind* (HoM) [7]. These instances were transcribed and then coded by research staff who coded independently but worked collaboratively to resolve discrepancies as they arose. Overall, our qualitative coding of video surfaced three HoMs that bolster students' attitudes toward and affiliation with engineering. These are presented and discussed below.

Despite having collected engineering journals from youth in the study, our research team did not take the time to analyze them. While some journals were diligently completed, others were sparse, and yet others were blank entirely. From this, we have learned that journaling in OST may require a bit more explicit encouragement from the educator. Indeed, we heard from several youth participants that journaling was an in-school activity, not an OST activity.

Findings

EIA Instrument

Using a paired samples t-test to analyze the EIA, we found that all scores showed highly significant improvement PRE to NOW ($p<.001$). Means for all NOW items exceeded the values of the corresponding PRE items; similarly all three NOW factor scores were larger than the matching PRE scores. Standardized mean factor scores (and standard deviations) are shown in Table 6.

Table 6. Paired samples t-test

	Mean	Std. Deviation	Std. Error Mean	95% CI*		t	df	P<.001
				Lower	Upper			Sig. (2-tailed)
Enjoyment	-0.75	0.75	0.13	-1.00	-0.49	-5.93	36	<0.001
Value to me	-0.37	0.37	0.06	-0.50	-0.25	-5.98	36	<0.001
School	-0.66	0.66	0.10	-0.86	-0.45	-6.51	36	<0.001
Value to society	-0.61	0.64	0.11	-0.82	-0.40	-5.79	36	<0.001
Aspirations	-0.72	0.77	0.13	-0.97	-0.46	-5.66	36	<0.001

*95% Confidence Interval of the Difference.

These data clearly indicate that youth perceive a change in their interests and attitudes toward engineering after having engaged with the curricula. As they reflect between PRE and NOW, they are much more likely to report being interested in engineering, wanting to pursue engineering as a career, and thinking that engineering is important for our society, to name a few. To understand what may facilitate this shift in how they affiliate with engineering, we look toward the video data.

Video data

The process of coding revealed several practices, or habits of mind, that youth were using as they progressed through the engineering activities. Of these, three practices stood out both in terms of the frequency with which they were found, and in terms of their relation to the development of engineering attitude and affiliation. They are:

- Negotiate design decisions collaboratively
- Persist through failure
- Celebrate their successes

Negotiate design decisions collaboratively

Across both units, youth are asked to work together to design a solution to the given engineering challenge. This means that teams of youth are deciding together what their design will look like, which materials to use and how best to use those materials to create a successful design. This type of collaboration often requires compromise and can be difficult especially when teams are under a time constraint. Not all design decisions are negotiated collaboratively, however, those that are, involve youth who value the perspectives of their peers and are willing to put group success above individual success. This creates an environment where youth are being heard by their peers, regardless of whether their idea is the one that's chosen. In Transcript 1, we see a group of girls negotiating how to arrange their filter materials in order to create an effective water reuse process for use aboard the International Space Station.

Transcript 1. Youth negotiate design of water filter

Timestamp	Speaker	Caption
31:10	Rachel	This is going to be hard because we need to filter waste water into pure water.
31:15	Emily	That's going to take a lot of filtering. I'm thinking of putting this [cheese cloth] in first.
31:20	Rachel	We should put it [cheese cloth] on top [last].
31:23	Emily	Well, if these [cotton balls] get small they could slide through.
31:25	Rachel	I feel like we should put it [cheese cloth] on top though because we need like…
31:28	Daniela	No, we can put it [cheese cloth] crinkled at the bottom, then the cotton balls, then that one [second cheese cloth] gets filtered at the top.
31:33	Emily	Yeah!
31:35	Rachel	But, I feel like we need quite a bit of water because we're going to need to filter it like five times.
31:40	Emily	Yeah, but they said we could make more water if we need to.
31:42	Rachel	Oh, okay. Got it. Good.

In this brief exchange, a difference of opinion regarding the order and placement of filter materials is resolved quickly. Rachel, is unable to convince her teammates of her idea, however, her opinion was considered by the group and toward the end, she appears content with the chosen plan. Countless negotiations like this happen throughout the activities providing opportunities for youth to see their ideas validated. It's through this practice of *negotiating design decisions collaboratively* that youth come to see themselves not only as valued members of the team, but also as engineers and competent problem solvers.

Persist through failure

Failure is an integral part of engineering and as such, it is experienced often by the youth in this study. The failure of a design, especially one that the group has worked hard on, can be discouraging and can test the stamina and resilience of any individual or group. Persisting through failure requires an evaluation of what went wrong and a new plan for how to improve. Transcript 2 shows a group of three boys and one girl whose water tower has collapsed while testing. They immediately start discussing what went wrong and how they might improve.

Transcript 2. Youth persist through water tower failure

Timestamp	Speaker	Caption
1:00	Melissa	[Referring to the legs of the tower] I would have put them here and here.
1:02	Cody	This leg is strong but these two buckled.
1:10	Matthew	It looked like it fell that way because it didn't have enough weight.
1:17	Cody	I think it was the way we taped it at the base. It's only partially holding it up.
1:22	Ryan	[Re-enacting the failure of the design] See, it's tilting this way.
1:25	Cody	It's not taped well enough here. These two [legs] are taped great.
1:34	Matthew	So we need more tape.
1:45	Cody	A stronger base and more tape at the joints.
1:59	Ryan	I've got a good sketch of [an improved design] it.
2:01	Melissa	Me too!

Without a hint of discouragement, this group immediately begins discussing the points of failure, identifying poorly taped joints and an unstable base. They agree on necessary improvements and begin sketching their improved design. This sets them on a path to success and instills confidence that through persistence and iterative development, they can solve the given challenge. Through this process, youth develop a more nuanced understanding of engineering and their ability to problem solve.

Celebrate their successes

Opportunities for success abound in both units. However, that doesn't mean success comes easily. When youth are successful, it's often only after they have experienced failure. As such, we tend to see enthusiasm and celebration as youth discover that an improvement they made, resulted in success. From these celebrations we can infer that groups of youth felt the activity was meaningful and that they felt invested in a successful outcome. In Transcript 3, we see a group of girls who had previously dealt with failure, suddenly realize their new design has yielded better results. They test for pH and discover their filter has successfully created pure water.

Transcript 3. Celebrating an improved filter

Timestamp	Speaker	Caption
29:44	Emily	Oh wow! It [the pH] went down to 8. Oh my god.
29:45	Rachel	Great! That's pure.
29:49	Emily	We got pure water. Be happy. We got pure water.
30:01	Rachel	Holy crowbar.
30:02	Emily	We're going to keep on doing this.

		[To returning group member] We got pure water!

When success is achieved, especially after encountering failure, it is an affirmation of the improvements, the hard work, and the persistence that was required. When youth celebrate their successes, they are acknowledging this affirmation and making it explicit. This act of *celebrating success* helps youth see themselves and each other as successful engineers and it promotes a positive affiliation with the discipline.

Youth focus groups

Largely confirming the results of the EIA, focus group data reveal youth who are confident in their abilities to engineer and in their understanding of what engineers do. Some youth report being interested in engineering as a career, while most report feeling confident that they *could* be an engineer if they wanted to be. In addition to their career aspirations, youth were eager to recount the engineering successes and failures that they encountered. This included many references to the challenge of working collaboratively. This suggests that their experiences, working in teams, negotiating failures and celebrating successes remained salient, even after the last activity had ended.

Conclusion

As industry leaders call for more engineering graduates to fill the jobs of the future, educators and curriculum developers are tasked with engaging youth, and providing experiences that pique their interests. While previous research has shown that engagement in engineering, fosters engineering interest [12], there had been little research into *how* interest and affiliation were facilitated. Through primary data collection in the out-of-school time setting, this study advances the field's understanding of the process by which OST youth develop interest in and affiliation toward engineering. Qualitative analysis of video data, revealed three engineering practices, or habits of mind, that play a role in the development of interest and affiliation: *negotiating design decisions collaboratively*, *persisting through failure,* and *celebrating success.*

The identification of these practices has relevance for OST educators who are facilitating engineering with growing numbers of youth [5]. Given their role in shaping attitudes, educators may consider curricula and activities that support these practices. They may also choose to create space and time within their setting, allowing youth, engaged in engineering activities, to fully explore these practices. There may also be relevance for developers of engineering curricula. While these practices are central to the discipline of engineering, it remains the job of the curriculum developer to decide how, and to what extent they are incorporated. The curriculum developer must also consider the scaffolding necessary to support educators' understanding of these practices and their importance as they relate to attitude and affiliation.

Acknowledgements

This material is based upon work supported by NASA under cooperative agreement award number NNX16AC53A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration (NASA).

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Appendix A

EIA Instrument

[redacted]

9/26/2016 [redacted]

Marking Instructions

- Use a No. 2 pencil or a blue or black ink pen only.
- Do not use pens with ink that soaks through the paper.
- Make solid marks that fill the response completely.

CORRECT: ●

INCORRECT: ∅⊠◒◔

Name:______________________________ Date:____________

I am a:

○ Girl

○ Boy

We are interested in learning about your opinions of engineering in this survey. Please answer each question honestly. Mark how strongly you agree or disagree after each statement. Thank you very much!

		Strongly Disagree	Disagree Somewhat	Not Sure	Agree Somewhat	Strongly Agree
1. I enjoy studying engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
2. I would like to work with other engineers to solve engineering problems.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
3. We learn about interesting things when we do engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
4. It is important for me to understand engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
5. Engineering is fun.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
6. When we do engineering, we use a lot of interesting materials and tools.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
7. Engineering helps me to understand today's world.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④

PLEASE DO NOT WRITE IN THIS AREA

[SERIAL]

		Strongly Disagree	Disagree Somewhat	Not Sure	Agree Somewhat	Strongly Agree
8. It is important to understand engineering in order to get a good job.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
9. I am interested when we do engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
10. Engineers help make people's lives better.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
11. I would enjoy being an engineer when I grow up.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
12. Engineering is useful in helping to solve the problems of everyday life.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
13. We learn about important things when we do engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
14. Engineering is easy for me.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
15. Engineering is really important for my country.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
16. I try hard to do well in engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
17. I would like to learn more about engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
18. I know what engineers do for their jobs.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④
19. I really want to learn engineering.	Last summer, I would have said:	⓪	①	②	③	④
	Now I would say:	⓪	①	②	③	④

Appendix B

Youth Focus Group Discussion Guide

- What did you think of the unit you just finished?
  - Did you enjoy it?
  - What was most fun for you?
  - What was most interesting to you?
  - What was the hardest part?
  - What would you change?
- What did you think of working together as a team?
- If you were to try a different engineering challenge, would you do anything differently?
  - Are you interested in trying another engineering challenge?
- What did you learn about engineering?
  - Are there things you learned how to do in this unit that you think would be useful in other ways?
- Do you feel like you could be a professional engineer someday if you wanted to?
- Would you want to be an engineer?